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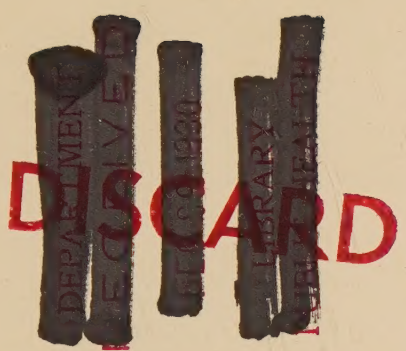
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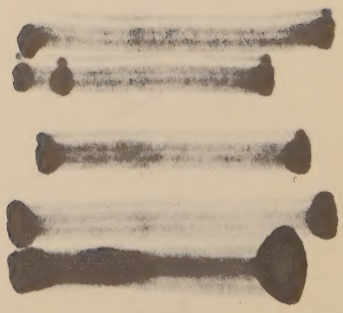
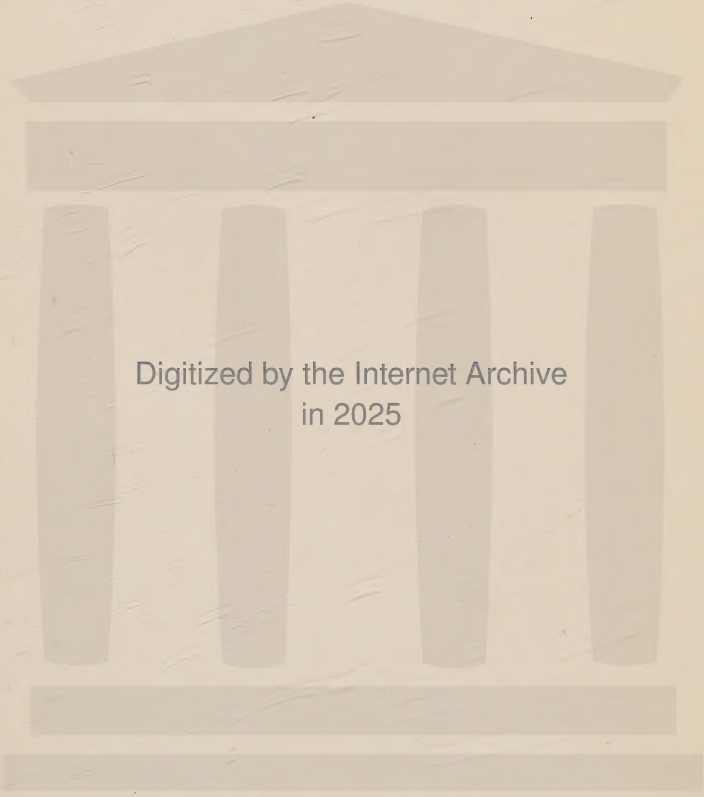


Pioneers of Public Health



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The London School of Hygiene and Tropical Medicine from Keppel Street.
From a drawing by J. D. M. Harvey.

[*Frontispiece*

Pioneers of Public Health

The Story of Some Benefactors of the Human Race

BY

M. E. M. WALKER

WITH FOREWORD

BY

SIR HUMPHRY ROLLESTON, BART., G.C.V.O.

Regius Professor of Physic, Cambridge

OLIVER AND BOYD

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TO THE
BRIGHT MEMORY OF MY ONLY SON
RONALD B. WALKER
B.A. OF KING'S COLLEGE,
CAMBRIDGE
WHO DIED IN THE TROPICS
MAY 1928

PREFACE

THESE slight sketches of the lives and works of the eminent scientists who form the subjects of the essays contained in this book, were suggested to me by seeing their names written large on the walls of the new building of the London School of Hygiene and Tropical Medicine as I walked down Gower Street one day in August 1928. If apology is needed for trespassing on well-trodden ground, and I make no claim to anything original or new in what is here written, my excuse must be that these sketches are intended to interest the passer-by in the street to whom, though the names may have for the most part a familiar sound, the work of these men, work which so nearly touches all our lives, is but vaguely known. For the work of scientists, perhaps from its very nature, has never attained the recognition it deserves, nor the publicity which attaches to the work of public men in other walks of life. But nowadays, when Medical Science in its steady advance occupies so prominent a place in the destinies of mankind, it behoves every one of us to have some acquaintance with the history of those pioneers whose labours won for us the manifold benefits we enjoy to-day.

The science of Public Health is a very ancient one. It was practised in Rome in the sixth century

B.C., but its advance has always been contingent upon the support of public opinion. Many an explorer's efforts have been wasted and forgotten, for lack of that support when they were new.

In our day the world is largely indebted to the Rockefeller Foundation of New York, whose munificence in providing the means for carrying out research work in every quarter of the globe is justly famous; and not the least among their benefactions is the generous gift which has enabled the London School of Hygiene and Tropical Medicine to find at last so splendid and fitting a home. In this country the name of Lord Melchett, Chairman of the Board of Management of the School, is fittingly associated with the pioneers of Public Health, since among the leaders of industry he has so ably applied the science of hygiene to our industrial life.

Appended to each essay is a list of the biographies and references from which the information contained in the text has been taken. If any of these sketches serve to stimulate the reader's interest in the subject sufficiently to send him to the original biographies, their author's object will have been fully attained.

My thanks are due to Professor Elliot Smith of University College, London, without whose encouragement this work would not have been written; to Sir Andrew Balfour, Director of the London School of Hygiene and Tropical Medicine, for kindly placing his notes at my disposal, and for the plates of many of the portraits; to Dr John D. Comrie of Edinburgh University for much helpful advice; to the Council of

the Royal College of Physicians of Edinburgh for the facilities of their Library, and especially to Mr Graham, their Librarian, and to the late Dr Macrae Taylor. And also to Colonel H. E. M. Douglas, Royal Army Medical College, London. For information about the American scientists I am much indebted to Professor C-E. A. Winslow of Yale University; to Lieutenant-Colonel Fielding Garrison, Librarian, Army Medical Library, Washington; to Miss K. Robertson, Smith's College, Massachusetts, for notes made on my behalf; and to Mr Parsloe, Librarian of the Institute of Historical Research, London.

M. E. M. WALKER.

TIGH-NA-ROSAN,
NAIRN, 1929.

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FOREWORD

THE aim of the London School of Hygiene and Tropical Medicine, so generously aided by the Rockefeller Foundation of New York in accordance with its appropriate motto "The Well-being of Mankind throughout the World," is the promotion of medical research and education, two activities which should never be separated. As the ideal of Medicine is the prevention of disease, the word *Hygiene* rightly takes precedence in the title of this School, for Tropical Medicine includes curative as well as preventive measures. Research is directed towards the future, for its object is the creation of new knowledge whereby human life may be prolonged and saved. It should, however, be remembered that investigation of a problem demands thorough acquaintance with what has gone before, and, to quote the late Sir Clifford Allbutt, "We cannot know modern medicine unless we study it as a whole, in the past as well as in the present."

It is therefore fitting and right not only that, before entering the School, visitors and students should have their attention drawn, by the names standing out in bold relief on the façade of the new building, to the pioneers who first explored the fields of public health and tropical medicine, but also that

information about these fathers of medical science should be available in a clear and convenient form.

In an interesting manner Mrs M. E. M. Walker describes the lives and achievements of twenty-one men eminent in the various branches of knowledge which go to make up hygiene and tropical medicine; for the more science develops on special lines, the more important does the influence of other branches of knowledge become, and, in addition to what might strictly be regarded as public health or hygiene and tropical medicine, there are essential lines of cognate investigation; for example, bacteriology which Pasteur founded, Koch developed, and Lister applied, to make surgery safe; protozoology which owes much to Timothy Lewis, Laveran, Manson and Leishman; and the science of statistics, begun by John Graunt and William Petty in the seventeenth century and much developed by William Farr in the last century.

The selection of those who should thus be kept in perpetual memory as examples to the workers in the School was carefully considered by a committee, for it is obvious that there might be different opinions on this delicate decision; for instance, some might be inclined to head the list with Hippocrates, the Father of Medicine, instead of Thomas Sydenham, the English Hippocrates, to whose views on epidemiology recent years have seen a return. Of the twenty-one names finally chosen, twelve are British; four from the United States of North America—amongst them Shattuck the layman and Hermann Biggs, the altruistic worker in the field of preventive medicine;

three from Central Europe, including Frank, "a modern of the moderns," and Pettenkofer, who was for long a household name upon the Continent; and two from France. Science of course knows no boundaries or nationalities, but this country can boast of a number of pioneers, such as James Lind, the naval, and John Pringle, the military hygienist. A century later, Manson laid the foundations of modern tropical, perhaps better called exotic, medicine; Edwin Chadwick, John Simon and E. A. Parkes placed public health and its administration on a sound basis; and Edward Jenner, as one out of due time, anticipated preventive medicine by the discovery of vaccination against smallpox. These early and later advances have abundantly borne fruit, as is perhaps most strikingly shown by the results obtained from protective vaccination against fever, by the prevention of disease in the Panama Zone through the efforts of the late General W. C. Gorgas, and by the mastery of Yellow Fever, thanks to the researches of Walter Reed and his devoted colleagues.

HUMPHRY ROLLESTON.

THOMAS SYDENHAM
1624-1689

Engraved by Goldar, after the painting by Sir Peter Lely, representing Sydenham in later life.

THOMAS SYDENHAM, M.D.

1624-1689.

SYDENHAM has been called by Dr John Brown, the famous author of *Rab and His Friends*, "the Prince of Practical Physicians," and he is generally regarded as the founder of English Medicine, "the English Hippocrates." He was certainly the forerunner of the modern science of epidemiology. Before his day no systematic account had been given of the history of fevers and epidemics, nor had fevers been classified; and by his method of exact observation of the symptoms of disease at the bedside, and of recording the results of his treatment, Sydenham showed the way by which the Art of Medicine must develop if it was to serve mankind, and earn the respect due to a learned profession. If he was often wrong in his theories as to the causes of disease, as, indeed, he was bound to be considering the state of medical knowledge in his day, yet he was essentially right in his conception of how to learn, and upon his methods, carried out at a time when they were contrary to all current practice, which was based on theories divorced from clinical experience, modern medicine developed.

Thomas Sydenham was born at Wynford Eagle in the County of Dorset in 1624, being the fifth son of William Sydenham and Mary his wife, a daughter of Sir John Jeffery of Catherston. He came of a

Puritan family of old descent, who had owned land in Dorset for many generations, many of his ancestors being "distinguished in arms, statecraft, and letters," as Dr Payne, his biographer, says. In the time of Queen Elizabeth one of these ancestors married Sir Francis Drake. Little is known of his mother's family beyond the fact that her father was a knight of some wealth and position in the county and she herself a woman of great piety, probably of the same faith as her husband. The Puritan connection made it inevitable that the Sydenhams should take an active part on Cromwell's side in the Civil War, and Thomas Sydenham, having been sent to Oxford at the age of eighteen, had not been there more than a few months when his studies were interrupted by the quarrels of the King and Parliament. Oxford was a stronghold of the Royalists: Sydenham had been entered at Magdalen Hall, the popular Puritan College of the day. He was, therefore, a marked man from the outset; but there is no reason to suppose, given the traditions of his family, that he would not in any case have been proud to enlist in the cause of "the rebels" by which name, rather than that of Roundhead, the Parliamentarians in Dorset were known. He saw much sharp fighting between the Royalists and Parliamentary troops in his native county, and was wounded more than once. Dorset was Parliamentarian almost to a man, with the exception of the district round Corfe Castle, and the family of Sydenham played a prominent part in the war, one member of it, Sydenham's brother probably, being in command of the forces besieging Corfe. The most tragic outcome of the war for the family was the loss of their mother, a delicate lady, who met her

death, it was reported, at the hands of the Royalists. Four of her sons, two of whom lost their lives, were fighting. Her death was avenged later, the story goes, by a Sydenham, who meeting his mother's murderer in a battle, "slew him in the place, who fell dead under his horse's feet."

Four years elapsed before Sydenham returned to Oxford to resume his studies in 1646. He relates in the preface to the 3rd edition of *Observationes Medicæ*, how on returning to his interrupted work, he had "the good fortune to fall in with the most learned and honourable Dr Thomas Coxe," who asked him what profession he intended to pursue. "I had at that time," says Sydenham, "no fixed plans, and was not even dreaming of the profession of medicine; but, moved by the recommendation and influence of so great a man, and in some way, I suppose, by my own destiny, I applied myself seriously to that pursuit. . . . After spending a few years in the University, I returned to London and entered on the practice of medicine."

In 1647, when Sydenham must have been still at Oxford, Parliament appointed "Visitors" "to purge the University," as the vigorous Puritan expression describes the proceeding, of all those who refused to take the covenant or opposed Cromwell's rule. Naturally a University of Royalist tradition did not submit without resistance, and in 1648 the Earl of Pembroke, who was then Chancellor, was sent down with an armed guard to compel submission. Many Royalists were deprived of their places which were filled by Puritans, and Sydenham, being a strong supporter of "the Visitors," was created Bachelor of Medicine on the 14th of April 1648, "by command

of the Earl of Pembroke." The custom of conferring degrees by patronage was common at this time, risky as it appears in our day that a man should be thus entitled to practise medicine. Sydenham had left Magdalen and entered as a Fellow Commoner of Wadham in 1647, and in October 1648 was appointed by the Visitors to a Fellowship of All Souls' College, and in March of the following year became Senior Bursar of the College. At All Souls' he made the acquaintance of Thomas Millington, afterwards Sir Thomas, one of the originators of the Royal Society, and Christopher Wren, as a Fellow of the College, was his colleague. Another and intimate friend of his, as noted by Dr John Comrie in his book, *The Selected Works of Thomas Sydenham, M.D.*, was John Locke, the philosopher, who was domestic physician to Lord Shaftesbury. In a letter to Dr Mapletoft, Sydenham describes Locke as "a man who, in the acuteness of his intellect, in the steadiness of his judgment, in the simplicity (and by simplicity I mean excellence) of his manners, has among the present generation, few equals and no superiors." Although the founders of the Royal Society, "The Invisible College," held some of their meetings at Oxford at this date, there is no evidence that Sydenham ever attended them, and his antipathy to anatomy and to physiology seems to have prevented him taking any part in the activities of this Society in London at a later date.

In 1655 he resigned his Fellowship of All Souls', and, having petitioned and received from Cromwell a gratuity for injuries suffered in the war (most probably in the second war against Charles II.), went to London to settle in practice in Westminster among

the politicians and statesmen of the day. The reply appended to the petition in the Record Office runs thus :—

FRIDAY, *3rd March* 1653-4.

"His Highness being very sensible of the matters represented in this petition, is pleased in an especial manner to recommend it to the Council that they may give the petitioner due satisfaction and that with all convenient expedition."

"(Signed) J. SADLER."

The "due satisfaction" amounted to £600, a sum equivalent to about £2000 at the present day.

In this year, 1655, he married Mary Gee, about whom very little is known, except that she came from his own county of Dorset. The house in which they set up in King Street has now been demolished with the street, but it was not very far from Parliament Street. At this time St James's Park and Pimlico were a stagnant marsh, providing a veritable hotbed of the agues and fevers with which Sydenham's writings are so largely concerned. In an *Epistolary Dissertation on Confluent Smallpox to Dr William Cole*, he says, fevers, "with their attendants, constitute two-thirds of the diseases to which mankind are liable," a very much higher proportion than is the case to-day.

It is on record that Sydenham was appointed in 1659 to the Office of "Controller of the Pipe," a department of the Court of Exchequer concerned with the registering of leases of Crown Lands. In 1660, however, the Restoration came, and, possibly to avoid any unpleasant consequences to

one so tainted with Cromwellian associations, Sydenham went abroad for a few months, and, it is supposed, studied under Barbeyrac, a celebrated French physician at Montpellier. The exact date of his return to London is not recorded, but it must have been about the summer of 1660, as he speaks of having the gout in London at this time and his record of the epidemic fevers of London began in 1661. He moved in 1664 to a house in Pall Mall, close by St James's Palace, a house which in those days had an extensive view over the Park and the fields beyond. After passing three obligatory examinations, he was admitted a licentiate of the College of Physicians in 1663. It was then illegal for anyone to practise within ten miles of London without this licence, and therefore when Sydenham practised in King Street, the rule must have been overlooked on account of his political connection.

In 1666 he published his *Methodus Curandi Febres*, translated later into English under the title *Method of Curing Fevers based on Original Observations.* His writings were published in Latin, according to the mode of his day, one result of which was that they could be read immediately in every European country without translation, and Sydenham acquired a great reputation abroad. The celebrated Dutch physician, Boerhaave, is said to have held his name in such respect that he doffed his hat every time it was mentioned. The first edition of this work was dedicated to Robert Boyle, the eminent natural philosopher, and one of the founders of the Royal Society, who was the first to demonstrate the necessity of air in maintaining life. He was an intimate friend of Sydenham and used to accompany him, although

he was not a doctor, on his visits to patients in order to satisfy his purely scientific interest in the cases. From the moment of publication the book attracted wide attention. It was reviewed at length in the *Philosophical Transactions* of the Royal Society, and a second edition appeared in 1668. When it was published in its final form under the title, *Medical Observations concerning the History and Cure of Acute Diseases*, it contained a complete record of the epidemics in London between the years 1661 and 1675, which, of course, included the year of the Great Plague, 1665. During this year Sydenham was advised by his friends to leave London, and it is probable that in the general exodus that took place, there were none of his patients left, for the poor were not then attended by the regular College physicians, whose practice for the most part was among the well-to-do, but by the surgeons and the apothecaries. And the dread of plague, accumulated through the centuries, was such that all who could possibly afford to do so, ran from before it. When we consider that in a population of about 400,000, about a fifth died of plague during the epidemic, and that at the crisis the deaths amounted to 7000 a week, the flight of the wealthy is hardly matter for surprise. That the fashionable doctors went with the crowd, is perhaps more surprising, and can only be accounted for by the fact that they had no patients to attend to. The apothecaries who stayed behind made their fortunes, not only by selling so-called cures for the plague, but also by the sale of "preventive" medicines, for which the credulity and fear of the people provided a ready market. Sydenham must have seen many cases at the beginning of the epidemic, and he returned

to London before it ended, missing only the crisis in the height of summer.

Sydenham was remarkable for his enterprise and initiative in introducing new methods of treatment; and, in an age of over-physicking, for his foresight in letting Nature take her own course whenever possible, untroubled by what he describes as "the over-officiousness of the physician." He was the first to describe scarlatina, and was largely instrumental in spreading the use of cinchona bark (quinine) for malaria. He divided fevers into two classes, those which he called stationary, and those which he called intercurrent, "because they are mixed with all kinds of stationary fevers, and likewise with each other indifferently." He placed in the intercurrent class "scarlet fever, pleurisy, bastard peripneumonia, rheumatism, erysipelatous fever, the quinsy, and perhaps some others," all of which are, as Dr John Comrie has pointed out in his able work above quoted, "in the modern view regarded as general diseases with local manifestations."

In the treatment of smallpox, Sydenham introduced what is known as "the cooling method," based upon the principle of the treatment of disease by contraries, and a story is told of how the idea occurred to him. The old method of treating smallpox consisted in shutting the patient up in a very warm room with every window closed, and piling blankets upon him till he lay in a bath of perspiration. It is reported that one patient being so treated became delirious and, thinking he was suffocating, burst free of his attendants and bedclothes and rushed into the open air. The effect upon his health was so beneficial that he began to recover, and thereafter Sydenham, whose

practice it was to follow Nature, employed the "cooling method." Whether or not the story is true, the "cooling method" became the vogue, and, harsh as it appears to us at the present day, it seems to have been more effective in the cure of smallpox than the usual treatment of the day, for Sydenham won some renown by its introduction. One of his patients who recovered has thus described the drastic steps taken to effect so happy an issue: "I went abroad by his direction, till I was blind, and then took to my bed. I had no fire allowed in my room, my windows were constantly open, my bed-clothes were ordered to be laid no higher than my waist. He made me take twelve bottles of small Beer, acidulated with Spirit of Vitriol, every twenty-four hours."

Another cure of a fantastic nature practised by Sydenham originated in his firm belief that the aged and feeble could be revitalised by bringing them in contact with the "Spirits" of the young. Being called in for consultation, he is said to have cured "Bishop Monk's Lady," whose case had been given up on account of her age and infirmity, by the "speedy transplantation of some young Spirits upon her," to effect which he had a young girl of thirteen put into her bed. It is reported that the girl fell sick of some contagion, but that Sydenham and the old lady's doctor "recovered her."

Sydenham had the idea that he had enemies and detractors in the medical profession, and that it was for this reason he was never elected a Fellow of the College of Physicians, and was denied the patronage of the Royal Family. He said to his friend Dr Andrew Broun, who came from Edinburgh to make

his acquaintance and who became one of his greatest admirers, that in spite of all his efforts in the cause of medicine "he had only gained the sad and unjust recompense of calumny and ignominy, and that from the emulation of some of his collegiate brethren and others, whose indignation at length did culminate to that height, that they endeavoured to banish him, as guilty of medicinal heresies, out of that illustrious Society." If this be true, it is nevertheless recorded that the College accorded high praise to his works and he had undoubtedly many friends among the Fellows. There was a certain Gideon Harvey, physician to the king, and one described as a "writer of scurrilous pamphlets," who referred to Sydenham as "a trooper turned physician," and a "Western Bumkin, that pretends to Limbo children in the Small-pox by a new method"; but this man was said to have borne some enmity to the College of Physicians for the reason that he was never admitted to membership of that body. Charles II., though he patronised medicine, was not particular as to the character of those he appointed his physicians, but Gideon Harvey seems to have been a man of some wit, if of little probity. He delighted to mock the medical practitioner, one of whose duties it was, according to him, to be seen regularly at church: "The church door shall no sooner be opened but *ecce* Mr Doctor, sitting in the most visible seat, Grave, Deaf, Dumb, and immoveable as if an Apoplexy of Devotion had seized him, out of which his Apothecary is to raise him by knocking at half-sermon at his pew-door to fetch him away post to a dying patient; by which means he draws the eyes of the whole congregation after him; but instead of going to the

pretended House of Visitation they both drop into a cabaret, there to pass the fatigue of a forenoon Sunday."

Like Sir Patrick Manson, who lived two centuries later, Sydenham was a lifelong sufferer from the gout, and at the age of fifty-seven considered himself too old to go beyond his house for company in the winter evenings. His *Treatise on the Gout*, written to while away the long evenings, is the best known of his works, and is a valuable history of the disease and its treatment in his times. He was a vivid writer, and in spite of his sufferings when he wrote this treatise, describes with a master hand the condition and its cure, or mitigation, with many philosophical reflections interjected :—

"But what is a consolation to me, and may be so to other gouty persons of small fortune and slender abilities, is that kings, princes, generals, admirals, philosophers and several other great men have thus lived and died. In short, it may, in a more especial manner, be affirmed of this disease that it destroys more rich than poor persons, and more wise men than fools, which seems to demonstrate the justice and strict impartiality of Providence, who abundantly supplies those that want some of the conveniences of life with other advantages, and tempers its profusion to others with equal mixture of evil; so that it appears to me universally and absolutely decreed that no man shall enjoy unmixed happiness or misery, but experience both; and this mixture of good and evil, so adapted to our weakness and perishable condition, is perhaps admirably suited to the present state."

Sydenham died in December 1689, at the age of sixty-five, and was buried, where later Sir John

Pringle and other illustrious members of his profession were to find their rest, in the Church of St James's, Piccadilly.

References.—*Thomas Sydenham*, by J. F. Payne, M.D. Oxon.: T. Fisher Unwin, London, 1900. *Selected Works of Thomas Sydenham, M.D.*, by John D. Comrie, M.A., B.Sc., M.D., Lect. in Med. Hist., Univ. of Edin. Bale, Sons & Danielsson, London, 1922.

Sir JOHN PRINGLE, Bart.

1707-1782

From the portrait by Sir J. Reynolds in the Royal Society, reproduced by permission of the Council.

SIR JOHN PRINGLE, BART., M.D., F.R.S.

1707-1782.

In Hill Burton's *History of Scotland*, we may find the following reference to one of Scotland's great sons :—

"Sir John Pringle rose to wealth and rank. It has been questioned whether he deserved all he gained, and the wits of the day sneered at him for sitting 'in Newton's Chair' as President of the Royal Society. But his services have been re-examined, and more amply appreciated, in the present day, by those who hold that it is a duty of science not only to cure disease when it comes, but to intercept its approach. When the advocates of sanitary science—not yet forty years old—looked back among the writings of physicians to find those instances where the premonitory causes of epidemics and other gregarious forms of disease had been most carefully and skilfully noticed, they found them in the collection made by Sir John Pringle from his experiences as a military surgeon."

Had the "wits of the day" lived to see the name of Pringle recorded prominently on the walls of the London School of Hygiene and Tropical Medicine in grateful memory of his work, they might have had to reconsider their verdict, for the laugh, as the Irishman said, would have been on the other foot.

The descendant of "an ancient and honourable" family, John Pringle was born at Stitchel House in Roxburghshire, on the 10th of April 1707. His father

was the second baronet of that name, his mother a sister of Sir Gilbert Elliott of Stobs, and John their youngest son. He was educated privately, as was usual among county families at this time, until at an early age he went to St Andrews University, where he had a relative, Mr Francis Pringle, Professor of Greek, who took charge of his education. In October of 1727 he entered the University of Edinburgh, but remained there only one year. According to Boswell, of whom Pringle was an intimate friend, as recorded in the *Life of Johnson*, a mercantile career had been chosen as the one best suited to Pringle's abilities, and he was sent to Amsterdam to learn business. Then there intervened one of those strange events for which in the old days Providence was usually held to be responsible, but which would now probably be attributed to the guidance of some subconscious urge. Happening to be in Leyden one day, and without any thought of adopting a medical career, Pringle's curiosity led him to the lecture room of the famous physician, Boerhaave, and this incident altered the whole course of his life. So impressed was he by the words of this pioneer of medical instruction in Europe, to whose inspiration British Medicine and British well-being, says Dr Charles Singer in his *Short History of Medicine*, owes an incalculable debt, that he resolved to become a medical student, and with that end in view entered the University of Leyden. He studied under Boerhaave and Albinus, the first anatomist of the day, and made friends with a man who afterwards rose to distinction in the profession, Van Swieten of Vienna. In two years' time, in the year 1730, he qualified M.D. of Leyden University, and delivered his inaugural address, *De Marcore*

Senili, which he dedicated to his relative, Francis Pringle, then President of the College of Physicians of Edinburgh, and, returning to Scotland, set up in practice in that city.

It is said that he paid great attention to the subjects of natural religion and morality and, whether on this account or not, he was nominated by the Magistrates and Council of Edinburgh in 1734 to a joint professorship bearing the quaint title of "Professor of Pneumatics and Moral Philosophy," the pneuma being a subtle spirit which was supposed to permeate the body. The sharer and original holder of his Chair was a Mr Scott, on whose death Pringle was to become the sole possessor of the professorship. Meanwhile he continued to practise medicine. Among the duties of his office as Professor of Pneumatics was the annual delivery of addresses upon the immateriality and immortality of the soul, a duty which he is said to have carried out with great zeal and ability. And perhaps it was in this connection that he asked Boswell to obtain Johnson's opinion as to which were the best English sermons for style, as Boswell relates in his *Life of Johnson*. Johnson himself was never on friendly terms with Pringle, much to Boswell's chagrin, holding, perhaps, that the views of the Scotsman were too unorthodox, for although Pringle was a great student of divinity, he had grave doubts as to the interpretation of the Bible, and eventually became a "rational Christian." This fact, combined with the great man's prejudice against those who came from North of the Tweed, would be quite enough to keep them apart.

Not to philosophy, however, does Pringle owe the high place he holds among famous men. In 1742 the

Earl of Stair was commanding the British Army in Flanders, and he appointed Pringle as his physician, giving him the charge of the military hospital. For his services he received twenty shillings a day, and the promise of half-pay for life when his active service ceased. The scourge of the armies in those days was chiefly dysentery and fever; but no record had ever been made of diseases to which armies in the field were peculiarly liable, and to Pringle is due the credit of being the first physician to give a careful account of his observations on the causes of military disorders, and to insist on sanitary measures for the health of the soldier being adopted in the battlefield and in cantonments, by which means he mitigated to a large extent the ravages of disease. In his researches into the causes of disease, he attributed much to the "peculiar conditions of the air," and blamed the "putrid air" in camps and gaols for the prevalence of dysentery in these places. His paper on the cure of dysentery, published in 1742 under the title *Vitrum Antimonii ceratum, a Specific Medicine in the Dysentery*, was long considered the standard work on this complaint. It was through Pringle's agency that the practice of regarding the hospitals in the field as exempt from attack by the enemy was first established. The Earl of Stair made the proposal to the Duke de Noailles, who commanded the enemy forces, and from that date a custom, by which many men were lost, of removing the sick on the approach of the enemy to a point far beyond the camp, was discontinued, and the hospitals were regarded as neutral territory.

Pringle's activities in the care of the wounded and the health of the armies in the campaigns of

1742 and 1744 did not escape the notice of those in command. The Duke of Cumberland gave him a commission in 1745 and appointed him "Physician General to His Majesty's Forces in the Low Countries and beyond the seas," and he was also made Physician to the Royal Hospitals in these countries. He then resigned his Chair in Edinburgh, the work of which had been carried on by proxy in his absence. His services to science were recognised by his election as a Fellow of the Royal Society in the same year, and in the following year, 1746, he was present at the Battle of Culloden against the Scottish rebels. In spite of the fierceness of the battle, he still seems to have had time to observe the conditions under which the troops had to live in the Highlands. In his work on *Medical Police*, Dr John Roberton quotes Pringle's authority in support of his theory of the unhealthiness of places where water collected. He says :—

"Sir John Pringle, in his account of the campaign in Scotland, comparing Fort Augustus to Fort William, observes that the former of these has always been a healthy garrison; but that the latter which lies towards the Western Coast, . . . has ever been sickly, and in particular, subject to agues and the bloody flux. On the Western Coast there are continual rains, and the fort stands in a narrow and moist valley, surrounded by mountains."

After leaving Scotland, Pringle went abroad again with the troops, but returned in 1749 and settled in London, when he received the appointment of Physician in Ordinary to the Duke of Cumberland.

In the years 1750 to 1752 he was engaged in experiments on putrefactive processes. His acumen

in discerning the relation between putrefaction and disease is remarkable, considering the elementary state of the sciences in his day, and he did not hesitate to make practical use of his knowledge. He advocated the use of ammonia as a disinfectant, "where manifest signs of putrefaction" had occurred. The results of his experiments were communicated in seven papers to the Royal Society under the title *Experiments on Substances resisting Putrefaction*, for which he was awarded the Copley Medal, and he also published at this time a letter addressed to the famous physician, Dr Meade, on *Observations on the Jayle or Hospital Fever*. Gaols were then a constant menace to the country's health by reason of the insanitary condition in which they were kept. Dr John Roberton in the work above quoted says of them :—

"Many who go into them in good health are, in a few months, changed to emaciated and dejected objects. . . . And it is a fact, that if confinement in such an atmosphere be persevered in, and the prisoners or inhabitants survive any length of time, they are not only rendered incapable of working, but many of them have their toes rotted from their feet. . . . It was Howard's opinion, . . . that our prisons were, in point of construction and internal management, much inferior to similar places in almost every other part of Europe which he visited. Surely this could not originate from want of airy situations. . . . It must therefore have originated from artificial, and consequently removable causes. . . . But while year passes after year and they still remain unnoticed, it would be difficult to determine whether the imprisoning or the imprisoned are the most guilty."

An alarming outbreak of gaol fever, even for those days when fevers were rampant, occurred at Newgate

prison, and we can imagine with what consternation the public mind was filled, when the prisoners at the Bar of the Old Bailey communicated the infection to the magistrates, and when the Lord Mayor, Sir Christopher Pennant, two judges, one alderman, along with forty other persons perished, from the disease. Pringle's paper dealt with the method of treatment and the means of prevention of gaol fever, and its early publication was calculated to allay public anxiety. It was finally amended and added to the work by which he is chiefly remembered, *Observations on the Diseases of the Army*, the first edition of which appeared in 1752. This work, dealing with his experiences with the armies since 1742, and the health of the British troops, ran through many editions, and was translated into many foreign languages. To its influence were due many improvements made in the hygiene of the Army, and the attention subsequently paid to sanitation among the troops. He describes the illnesses by which the soldiers were attacked, giving them in the order in which they occurred with an account of the conditions of place and climate; discusses the causes of diseases and "the means of removing some and rendering others less dangerous," and gives a description of the treatment employed and the means which were most effective in preventing the recurrence of disease. Pringle may, therefore, truly be called a pioneer in hygiene, for he was one of the first physicians to employ medical skill in the prevention of disease.

In 1761 he received the appointment of Physician to the Queen's Household, and in 1763 was made a Fellow of the College of Physicians. In 1764 he was appointed Physician in Ordinary to the Queen, and

in 1766 a baronetcy was conferred upon him. In 1774 he was appointed Physician Extraordinary to the King. He received many honours from learned societies abroad; in Paris, St Petersburg and Madrid, in Haarlem and Göttingen. And in 1772 the Royal Society paid him its most coveted compliment by electing him President.

Sir John Pringle is very remarkable for the wide range of his learning. He was indefatigable in scientific research, and not alone in medical subjects, as the varying titles of his observations testify. Among the papers he contributed to the *Philosophical Transactions of the Royal Society* are: "An Account of Several Persons seized with the Gaol Fever working in Newgate"; "A Remarkable Case of Fragility, Flexibility, and Dissolution of the Bones," in which it is said the unfortunate patient was reduced to the size of 2 ft. 2 in.; "A Letter upon the Extraordinary Agitation of the Waters"; "An Account of the Agitation of the Waters on the 1st November 1756, in Scotland and Hamburgh"; "An Account of the Case of the late Rt. Hon. Horace Lord Walpole"; and "An Account of the Virtues of Soap in Dissolving the Stone." He also contributed some accounts of "the Fiery Meteors" and other heavenly bodies, and was unsparing in his efforts to induce scientific research in others.

He wrote *Six Discourses* upon the work of six Copley Medallists, Fellows of the Royal Society, upon whom that honour was bestowed during his Presidency, leaving directions for their publication after his death. They were published by the Reverend Dr Kippis in 1783, prefaced by a life of Pringle. The manuscripts are now in the Royal College of Physicians, Edinburgh,

in Pringle's own hand. The subjects criticised in these papers are ample evidence of the diversity of learning that Pringle possessed, one of the medals being awarded to "the Rev. Joseph Priestly, LL.D., for his Observation on Different Kinds of Air," another to the Astronomer Royal "for his Observations made on the Mountain Schiehallion for finding its Attraction," and a third to Captain James Cook, "for an Account of the Method he had taken to preserve the Health of the Crew of His Majesty's Ship, *The Resolution*, during her late voyage round the world." In bestowing the medal "with Cook's unperishing name engraven upon it," on Cook's representative (for Cook himself had gone on his last voyage), Pringle said: "You will be happy to know that this respectable body never more cordially nor more meritoriously bestowed that faithful symbol of their esteem and affection: for, if Rome decreed the Civic Crown to him who saved the life of a single citizen, what wreaths are due to that man who, having himself saved many, perpetuates now in your *Transactions* the means by which Britain may henceforth preserve numbers of her intrepid sons, her mariners who, braving every danger, have so liberally contributed to the fame, to the opulence, and to the maritime empire of their country."

In 1778 Sir John Pringle retired from the Chair of the Royal Society, his health having been injured by the results of a fall. He paid a visit to Edinburgh, and even purchased a house there, intending to end his days in the country of his birth; but he found too many changes since his younger days, and his failing spirits did not revive. Death had removed his old friends, and even the climate, it would seem, had

changed for the worse. So, leaving to the College of Physicians of Edinburgh ten folio volumes of his manuscripts on medical and physical observations to recompense the City for his absence, he returned to London to spend his remaining years among his learned friends. Of these, a few used to meet regularly on Sunday evenings for conversation and the exchange of ideas at the house of a Mr Watson, a grocer, in the Strand, and Pringle was never absent, for to him these gatherings were a source of much delight. It was at one of these meetings that he was seized with his last illness. He died on the 18th of January 1782, in his seventy-fifth year, and lies buried in Wren's Church of St James's, Piccadilly, famous for the tombs of the great.

The photograph which accompanies this sketch is taken from his portrait by Sir Joshua Reynolds, in the possession of the Royal Society, and is published by the kind permission of the Council.

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JAMES LIND
1716-1794

From the portrait in the Royal Haslar Hospital.

JAMES LIND, M.D.

1716-1794.

THERE are many who have risen to fame on much slenderer grounds than the services which were rendered to his fellow-countrymen and the world at large by James Lind. Yet his name is not widely known in England to-day, nor was his work recognised and rewarded in his lifetime as was that of his compatriot, Sir John Pringle, whose labours for the hygiene of the Army brought him well-deserved honours and even wealth, a reward usually denied to the devotee of science. But what Pringle did for the Army was equalled, if not surpassed, by the benefactions conferred upon the Navy and upon all those who sail the seas by Lind. "If departed great benefactors of our race could now and then look down on the harvest-fields where mankind age after age is gladdened by the fruits of their labour," says Sir John Simon in his *English Sanitary Institutions*, "they would in general find themselves less remembered than perhaps their terrestrial ambitions had desired." Lind spent the greater part of his life in the study of scurvy, and when, after his death, his measures for the prevention of this devastating disease were adopted by all nations, scurvy disappeared and troubled seafaring men no more. And for this reason, perhaps, Lind is so little remembered now. "The thoroughness of the reformer's victory," says

Sir John Simon again, "is that which most makes silence of the reformer's fame." *The Dictionary of National Biography* disposes of Lind's work in a short notice; while almost as much space is allotted to his relative of the same name, who seems to have been a popular and amusing man who became Physician to the King, and is mentioned in Fanny Burney's *Diaries*. The most valuable account of Lind and his work is that given by Professor Stockman of Glasgow University in the *Edinburgh Medical Journal* for June 1926.

James Lind's father was an Edinburgh merchant and burgess, who came of an old family owning land in Ayrshire since the year 1207. Their name was derived from a linn or waterfall on their estate and was variously spelt, sometimes Lin, sometimes Lynd or Lind. He married Margaret Smellum, whose surname, too, was alternately written Smelum, Smellome, or even Smelholme, and whose relatives were physicians, Dr John Smellome being admitted a Fellow of the College of Physicians of Edinburgh in 1694. James Lind's great-grandfather sold his estates and settled in Edinburgh, where his family became well known in the society of the day, and by the time James Lind was born, on the 4th of October 1716, it held a high position in the city, a cousin of his father's being Lord Provost and another cousin Sheriff-Depute of Edinburgh.

At the age of fifteen, James Lind was apprenticed to medicine in the house of a surgeon named George Langlands, for it was the custom in those days for a young doctor to study under a physician or surgeon of standing; and, indeed, although instruction of a kind was given at that time in the Surgeons' Hall,

it was not till after Lind's apprentice days were done that clinical instruction was given in the Royal Infirmary, so that even if he attended the anatomy class, he must have learnt most of his medicine in private practice. The new town of Edinburgh was not then in existence and the 40,000 inhabitants of the city lived chiefly in the Canongate and the neighbourhood of the Castle, and according to John Roberton, an Edinburgh physician, whose work on *Medical Police* was published in 1809, the sanitary conditions and the habits of the people, even of the well-to-do, were such as must have given rise to plenty of work for the doctors.

When he was twenty-three years of age, Lind joined the Naval Medical Service, and spent the next ten years at sea, a great part of it in the tropics, where he gained his experience of tropical diseases, on which he wrote in later years a most valuable treatise. He served under Admiral Haddock at Minorca in 1739, and on the Coast of Guinea and in the West Indies. The conditions under which men lived at sea were appalling. The sailors were overcrowded in damp, dark and airless cabins, their dietary on long voyages often consisted, in Lind's own words, of "putrid beef, rancid pork, mouldy biscuits and flour," and he truly said, "the number of seamen in time of war who die by shipwreck, capture, famine, fire and sword is but inconsiderable in respect of such as are destroyed by the ship diseases, and by the usual maladies of intemperate climates."

In 1748, the year in which public clinical instruction was started in the wards of Edinburgh Infirmary, Lind left the Navy and took his degree at the University of Edinburgh, before setting up in practice

in that city, where he remained ten years. In 1753 he published his book on scurvy, printed in Edinburgh and entitled *A Treatise on the Scurvy*. A second edition was published in London in 1757, and a third, with many additions giving his later experience, in 1772. The first edition was dedicated to Lord Anson, First Lord Commissioner of the Admiralty, and this fact alone might have brought the matter of the treatment of this scourge to the notice of those in authority. Yet nothing was done. Lind was elected a Fellow and Treasurer of the Royal College of Physicians in Edinburgh; but he had not held this office for more than a year when he was appointed Physician to "His Majesty's Royal Hospital" at Haslar, and had to resign from the College. As chief physician at Haslar, his salary amounted to £200 per annum, in addition to which he was allowed to practise privately in his spare time. In a quaint letter which he wrote to the President of the College of Physicians shortly after he left Edinburgh, he describes the new Hospital at Haslar and the conditions under which he had to work, not omitting the Scotsman's contempt for brick as compared with his own stone buildings.

"Haslar Hospital is an immense pile of building & tho' of Brick will when finished have cost the Government about £100,000. It is surrounded by a high wall (to prevent desertion) containing 32 acres of ground. It will certainly be the largest hospital in Europe when finished. . . .

"The annual expence at present is £14,000 pr an. but then we never have had above 1040 patients, we this winter shall open wards for 500 patients more.

"The hospital is under the direction of the Physician

and Council—the latter consists of the Physician who presides, two master Surgeons, the Agent & Steward, and lately two new members are added. . . .

"But this Council must act entirely by Orders from the Board of Sick & hurt.

"Six upper assistant Surgeons at 5 sh pr Day & 4 under assistants at 3s. 6d. were allowed with an apothecary & two assistants but it is proposed to reduce the number of assistant Surgeons & increase the number of apothecaries, as these last are to be appropriated to visit with the Physician in his Wards.

"We are remarkably clean. No patient is admitted into the hospital until he is stripped of all his cloths & well washed with warm water & soap in tubs always kept for the purpose, he is allowed the hospital dress during the time he continues in the hospital or until his cloths are returned him quite clean, & he is regularly shifted and kept quite neat clean & sweet at the Government's expence. . . .

"In cases of fevers the Patients cloths are directly fumigated with Brimstone in the smoak house & baked in an oven sprinkled with vinegar. . . . We have sometimes 90 women nurses at a time their pay is £12 pr an. In our wash house we have seldom less than 24 women constantly employed. All these are under sober & discreet Matrons.

"We have about 20 Labourers at 1s. 6d. everyday, employed in the different branches of Duty in the House. And indeed no expence is spared for the regular management of the house. . . .

Dr Sir

Your most obedient and obliged hble Servant

JAMES LIND."

ROYAL HOSPITAL AT HASLAR.
3rd September 1758.

All the staff with their wives and families, excepting only the chief officers, lived together in the hospital and indiscipline and quarrelling were the order of the day; but Lind in the course of the twenty-five years in which he ruled there, seems to have carried out his duties in the interests of peace so far as the manners and customs of the times permitted.

There were 1000 beds when he was appointed, and in his first two years of office 5743 patients were admitted, of which 1146 were cases of scurvy. It was quite usual for the Channel Fleet to arrive at Portsmouth with 1000 or 2000 cases of scurvy, and Lind had, during the Seven Years' War with France and Spain, 300 to 400 cases under his daily care in hospital, so that his opportunities for carrying out the treatment recommended in his *Treatise on the Scurvy* were unique, and in the third edition of this work he adds to the original matter much of his valuable experience at Haslar. He adopted the experimental method of treatment, watching and recording the success or failure of different remedies on the cases under his care. In his day this alone was a long way in advance of current practice.

Scurvy had been known for centuries. It was common among the people who lived on the Baltic shores and those of the North Sea in the long sunless winters when no vegetables would grow, and when the diet was composed of salt fish. The knowledge that fresh vegetables and lemon juice were cures for the disease was traditional among many of the peoples, but the difficulty of procuring these things in the absence of much communication seemed insurmountable. The Dutch doctors were the first to write of the disease in the sixteenth century and, Professor

Stockman relates, they seem to have given accurate accounts of its causes, symptoms and cure. Then in 1588 a Dutch physician, Severius Eugalenus, published a work on scurvy which ran into seven editions, the last appearing in 1720, and although his description of the disease had little relation to any facts or symptoms of the scurvy, and was often hopelessly mixed up with the symptoms of other diseases, even pleurisy, agues and hysteria, this work was accepted and remained the authoritative account of scurvy for nearly two centuries. "I diagnose the disease as soon as I place my hand on the pulse," Eugalenus said, and accordingly he found scurvy everywhere, attributing it to the anger of God for sin. Quackery was rife in those times when any apothecary could make money by selling the physicians' prescriptions deposited by law at his drug house; and the credulity of the public was infinite; but it is amazing, as Professor Stockman remarks, that English doctors of the seventeenth century, including Dr Willis, one of the founders of the Royal Society, should have accepted the authority of Eugalenus without question, not discerning that far too many diseases were attributed to scurvy, when it was obvious that the failure of lemons, etc., to relieve a pleurisy, called the scurvy, would cause these one-time remedies to fall into disrepute.

Lind then had to demolish a mass of ignorance and prejudice which had lasted through two centuries, to pick out the true from the false, and build afresh on scientific principles. His study of all that had been written on the disease was stupendous, and must have involved laborious researches; but his recommendation for treatment was based upon his own clinical

experience at sea and at Haslar Hospital, and, as he himself says, he proposed "nothing merely dictated from theory," but confirmed "all by experience and facts, the surest and most unerring guides." He prescribes not only for the cure, but for the prevention of the scurvy, pointing out how crowding and dampness, and the general depression of spirits they breed in the seamen, are conducive to the spread of this disease, as well as the lack of fresh vegetables and greens. He seems to have been a man of great originality of thought, an accurate observer, and possessed of great industry, and those who came in contact with him were enthusiastic in their praise of his work; and yet it was not till forty-one years after the publication of his work on scurvy that his methods were adopted by the Admiralty, and by that time Lind was dead. He may have been lacking in the dominating will power necessary to enforce his views on those in authority, or it may have been that he was too far in advance of his time for his ideas to be accepted readily. Writing in 1809, John Roberton says of the reforming physician: "If he attempt to show the weakness of the fashionable system, or to introduce any alteration in the practice, the whole faculty are alarmed; their vanity is piqued in having opinions, which they thought perfectly established, brought into question . . . the effect of every deviation, which he makes from the common practice, is anxiously watched, all his prescriptions must remain upon the apothecary's file, to rise in judgment against him; and, upon any miscarriage, the outcry is raised and propagated with the utmost malignity. This diabolical plan of persecuting the proposers of improvements must, by repetition, change the conduct of

the most firm. Yet the discerning, who by-the-bye, are always the minority of society, will make the just distinction. They will, by comparison, know to whom the merit is due."

The "discerning" in Lind's case were his disciples, Sir Gilbert Blane and Thomas Trotter, both of whom wrote enthusiastically of his work. Sir Gilbert Blane, commenting upon the *Treatise on the Scurvy*, said: "This work is more complete in all points than any other work with which I am acquainted, upon any other medical subject"; and it was due to him, when he became a member of the Sick and Wounded Board in 1794, that the order was given for a ration of lemon juice to be supplied to a small squadron voyaging to the East Indies. On the flagship a daily ration was served out, with the result that she arrived at Madras after twenty-three weeks at sea without a single case of scurvy having occurred. The Channel Fleet having had the same experience, an order for a general supply of lemon juice to His Majesty's Ships was issued in 1795, and from this time the Fleet was rid of one of its most dreaded terrors.

The dilatoriness of Government procedure and the inertia of the Admiralty have been chiefly blamed for the delay in carrying out Lind's advice. As an illustration of administrative torpor Spencer in his *Study of Sociology* refers to the fact that for two hundred years the cure of lemon juice for scurvy had been known, and that Lind's work waited forty years for recognition; but Professor Stockman points out that the Admiralty was not lacking in the will to do something for this scourge, as instanced by the orders for a ration of extract of malt and other remedies which were issued.

He thinks the blame should "with more justice be borne by its medical advisers." For "Medical Schools and writers were obsessed with their theories, and when officially consulted, as they often were, gave very poor advice."

Lind's *Essay on the Most Effectual Means of Preserving the Health of Seamen in the Royal Navy* was published in 1757, a second edition following it in 1762, and a third, containing an extra chapter on gaol fever, in 1779. This work gives a very full account of measures of naval hygiene for ships at sea, directions for disinfection and for the destruction of vermin, for filtering water through casks of sand, or by charcoal, for the wearing of special clothes by surgeons who attend the sick, and the strict ventilation and cleanliness of the sick-berth. Before his day none of these things received attention. In 1768 he published *An Essay on Diseases incidental to Europeans in Hot Climates*, which gives a valuable summary of the diseases then prevalent in each British possession, and directions for avoiding them. As the conditions for Europeans in hot climates were at that period as a rule disastrous to the health of the white man, this work was greatly needed. It ran through five editions in Lind's life-time, and a sixth appeared after his death. To avoid fevers both at home and abroad, he advised people to live on high ground away from stagnant water, to the "effluvia" from which many fevers were attributed by medical writers long before the part the mosquito played in their distribution was known. Roberton, who was greatly indebted to Lind's writings and often quotes him in his work on *Medical Police*, refers to his belief in the dangerous effects of water: "Dr Lind, in his *Essay on Diseases*

incident to Europeans in Hot Climates, observes that the English Castle at Whydaw is reckoned more unhealthful than the neighbouring places, as the sea breeze in coming to it always passes over an inconsiderable brook of water, which produces some aquatic plants, always covered with a putrid slime." Lind also recommended the use of cinchona bark, as did his predecessor Sydenham, and his advice for the treatment and avoidance of malaria was well calculated to attain success although he was unaware of the true sources of the infection. He paid much attention to the dietary of sailors, and his device for distilling sea-water in cooking coppers in order to produce fresh drinking water at sea, was much appreciated on long voyages.

In 1783, at the age of sixty-seven, Lind resigned the office of Chief Medical Officer at Haslar Hospital for reasons of health, after twenty-five years of devoted service to the welfare of the Navy and the Hospital. He died at Gosport on the 13th July 1794, and was buried at Porchester. A tablet to his memory was put up in the church, but he received during his lifetime no honours and no recognition of his work. He was not elected a Fellow of the Royal Society, and no universities conferred upon him their honorary degrees. Yet his writings had a European fame, and seamen of all nationalities owed to his foresight and industry the revolution which took place in life at sea when his recommendations were enforced. He was one of the great pioneers in hygiene, for he saw, what is a commonplace to-day, but was unthought of in his time, that the health of individuals in every nation must be of the greatest importance to its prosperity and independence. In Roberton's vigorous phrase

he believed that "it was not one of the least of the duties of our Government to exert some of its influence to prevent . . . the community from having their constitutions blasted by such sources of contamination, and the original vigour of their minds destroyed by diseases, which for the most part, can be so easily avoided."

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JOHANN P. FRANK
1745-1821

From a copy of the portrait reproduced in his Autobiography.

JOHANN PETER FRANK, M.D.

1745-1821.

The name of Johann Peter Frank is much less known in England to-day than it deserves to be, for he was the true founder of modern hygiene in Europe, the first to insist upon the duty of the State in the care of its citizens' health, and the first to embody his teachings in the science of preventive medicine in a work which was designed for popular instruction. His book, *A Complete System of Police Medicine*, took him a life-time to write and was published in many volumes between the years 1779 and 1817. It dealt with every aspect of the health of man from the cradle to the grave, but Frank was so far in advance of his time and generation that many of the reforms he advocated were not put into practice till quite recent times. At the date he wrote, little foreign literature of a medical kind was read in England, and his book has not been translated into English even yet.

Even in the Victorian age, the awakening of the public mind to the dangers which accompanied the neglect of sanitary science was slow to take effect. The disastrous results of violent epidemics had to lay waste the land before any steps were taken to allay the plague, far less to prevent its onset. Dr James Russell, the second Medical Officer of Health appointed by Glasgow, has described in his work

The Evolution of Sanitary Administration in Glasgow, the spasmodic efforts that were made, as late as the middle of the nineteenth century, when Frank had been in his grave for twenty years, to cope with infectious diseases. He says: "Fevers as such were not dealt with preventively, only epidemics. Each epidemic was a tragedy. When it was played out, all the properties were dispersed and the stage left unfurnished. . . . The usual course of events was the rapid extension of the epidemic until the Infirmary Fever House was overflowing, then public excitement, public meetings, the appointment of a "Fever Committee," or a "Board of Health," as in 1832 and 1837, the collection of funds, a rushing about for sites for temporary hospitals, attendance at home, the organisation of a staff of fumigators, etc. Then the disease in due time began to decline; it shrank within the capacity of the Royal Infirmary; the hospitals were pulled down; the doctors, nurses, and fumigators who had not been buried, were paid off; a report of the receipts and disbursements was submitted, and the Board or Committee ceased to be. The play was over. . . . This evil method was not a feature of the locality. It was the method of the period. This was the fashion of the first instinctive effort at self-protection when the cholera spectre stalked the land." If Frank had had the good fortune to live in more peaceful times, in countries whose resources were less depleted by the ravages of war, his work might have attracted wider attention, and the science of hygiene might have been advanced by several generations.

Johann Peter Frank was born at Rotalben in Bavaria in 1745. It has been stated by Baas in his *Outlines of the History of Medicine*, that he was "a

man sprung from want," and literally left like a waif on the doorstep of a merchant by his cruel father, when he was nine months old. In his autobiography Frank tells rather a different story, and it seems probable that his childhood may have been confused with that of his father. His father, Nicholas Frank, was the only son of a French merchant, who settled in Mont Royal during the French occupation and married a German wife. When the French garrison withdrew, Johann's grandfather sent his German wife to her own people in Mannheim for safety, and himself retired with the Army, taking his little son Nicholas with him. Soon afterwards he was murdered and the boy was left to the care of the regiment. But the lad did not seem to like his guardians. At Heidelberg he slipped away from the Army and crossed the Rhine. A German merchant, wishing to have his children taught French, took him in, and gradually became attached to him on account of his honesty and good behaviour. Nicholas could not read or write much, but he was brought up in the merchant's business and learnt something of trade. When he was grown up he went to Frankfort to buy and sell wares, and was so successful in this business that he was able to earn his livelihood. His trading activities took him from town to town, and in Rotalben he fell in with Burgomaster Theobald Wurz who entrusted him with some business, and was so satisfied with the success of Nicholas's work that he gave him his daughter, Marie Margaret, in marriage. Nicholas soon amassed a little money and earned the reputation of being the most hard-working man in the district. He was then thirty years of age and his wife but a child of fourteen. They had a family of fourteen

children, one of whom was Johann Peter. Nicholas's romantic adventures culminated in the return of his long-lost mother. A friend of his, while in a tap-room at Frankfort, noticed a very old, neatly dressed woman sitting at her spinning-wheel in a corner. Falling into conversation with her, he elicited her story and guessed that she must be Nicholas's mother, sent so long ago to Mannheim. She was brought to Rotalben and lived with her son till she died in March 1745, at the age of 105. That year Johann was born.

He was educated at a Jesuit School in Rastadt. He worked very hard, but seldom was top of his class, a fact which he attributed to his inability to learn his lessons by heart. He never had them word perfect, and was greatly disheartened by the disparaging remarks of his teachers. Music was to him a great delight—one which lasted all his life. His soprano voice was so fine that at one time, when he was ten years old, the question was considered of sending him to Italy to train as a singer. But this drastic step was fortunately avoided, as it was regarded as unsuitable for the son of a well-to-do burgher. Frank was often in delicate health. He had quartan fever while a boy and could not throw it off. Instead of giving him the cure of cinchona bark, recommended by Sydenham, his mother, in accordance with the superstition of the times, bade him try the fashionable remedy which was to throw a live crab over his shoulder into the river. Placing no faith in such remedies even at that early age, Frank yet obediently carried it out, but told his mother that the crab "laughed itself to death over his quartan fever."

From the Jesuit School in Rastadt he went to Baden to learn rhetoric, and in 1762 he attended the lectures of a learned Jesuit in Pont à Mousson on the subject of Physic. These lectures inspired him with such a love of medicine that he decided to adopt it as a career, much to the grief of his pious mother, who had hoped to see him enter the Church. His father, too, was alarmed at the heavy expenses involved in the medical course, and threatened to withdraw his allowance unless he gave up the idea. But, undeterred by the remonstrances of his family, Frank pursued his course and finally received some help from a married brother while he studied at Heidelberg. He was a man of much independence of thought and often fell foul of his teachers, because he could not help arguing with them. At Heidelberg, the Dean of the Faculty had been a pupil of the celebrated physician Boerhaave, of whom it was said (so the story goes) that a letter addressed "Boerhaave, Europe," would always reach its destination. Frank's audacity in questioning some of the Dean's views during a lecture led to a quarrel, and he left Heidelberg to study physiology and anatomy at Strasbourg. When he returned to Heidelberg for his examination, the Dean received him coldly. His "oral" lasted one hour instead of the usual three, which in his anxiety he interpreted as being a sure sign of failure. But after he had waited what seemed an interminable time, he was informed that the brilliance of his replies had absolved him from all further examination. Much elated, he returned to Strasbourg and delivered his thesis before a large audience with great éclat. The friendly Dean at Strasbourg then advised him to take up some special line of work, but on hearing

the nature of the work which most appealed to Frank, the institution of a system of police medicine, he turned a cold shoulder on such a fantastic project.

In 1766, Frank married a German wife, and, having translated his thesis into French, he took a French degree at Pont à Mousson in order to be allowed to practise medicine in Lorraine. After two years at Bitsch, he returned to Germany and took up practice with an old doctor in Baden. With him he was sent by the Court at Rastadt to investigate an epidemic of fever in one of the neighbouring towns, an episode which brought him some good fortune, for on their return to Rastadt, the Prince's physician chose to keep them waiting so long for an interview that the old man went home in disgust, leaving Frank to cope with the situation. In reporting to the Prince, Frank acquitted himself with such distinction that he was later appointed Court and Garrison Physician at Rastadt.

The first volume of his book on *Police Medicine*, which he had been writing whenever he had leisure, was now ready and he looked round everywhere for a publisher, thinking, in his enthusiasm for this new idea of a State where everything was to be directed for the benefit of the health of its citizens, that such a work would be sure to enrich any man who printed it. But to his chagrin every publisher he approached refused him, and in bitter disappointment, he threw the whole volume into the fire. At the same time he lost his wife and child, a blow which turned his attention to the study of obstetrics and midwifery, in which branch of medicine he afterwards instituted many much needed reforms. He was appointed Director of the Midwives' Association in Baden,

and town and country physician in Bruchsal, where he had charge of the garrison hospital and a hostel for the sick poor, gaining thereby much clinical experience. In 1773 he received the appointment of Physician to the Prince-Bishop of Speyer, a man who was keenly interested in all philanthropical works, and gave his influential support to the reforms proposed by his enterprising physician. Among these was the foundation of a School of Obstetrics, in which Frank taught for many years.

By 1779, the first volume of *Police Medicine* had been rewritten, and was published in Mannheim by Schwan, the publisher of Schiller's *Robbers*. It was adversely criticised by a Frankfort journal on account of some passages in it deprecating celibacy, a deprecation which was considered contrary to the teaching of the Church, and there was some danger of the volume being put on the Index. Frank's advice was quite in harmony with the spirit of the times, which was conscious of the dangers arising from the dearth of men in the countries devastated by war, and the desirability of increasing the birthrate. The book was not well received by the Church, however, and in the preface to the second edition, Frank explained that he meant no reproach to the Church and apologised for any offence given. Nevertheless, he left the offending passages intact. The second volume appeared in 1780, followed by the third in 1783.

In 1784, Frank accepted a professorship in Göttingen, which he held for one year, when he was appointed Professor of Clinical Medicine in Pavia, under the patronage of Joseph II. of Austria. On his way to Italy he was received by the Emperor in Vienna, and shown round the large General

Hospital of which Joseph was not a little proud, for in these times all such enterprises were dependent upon the goodwill of princes. Frank's criticisms, though outspoken, pleased and flattered Joseph and kindled his interest in the wise physician.

In Pavia a very different atmosphere surrounded the University from that which prevailed in Göttingen. There were many doctors but only forty-four students, and of these most of them strolled in late for lecture and showed none of that desire for learning that was apparent in the Northern University. But soon all this was changed. Frank instituted many reforms and exercised a profound influence over the students. He drew up a plan of studies for the Medical School, and although this was never published lest the suggestions for reform coming from a foreigner should be resented, yet all its recommendations were put into practice, and revolutionised the teaching of the school. Practical teaching of anatomy and physiology was introduced, and a most important reform was initiated when the students were admitted to the hospital wards where, under the guidance of the experienced men in charge, they had opportunity for clinical study. In 1786, Frank was appointed *protophysicus* of Lombardy, and in this capacity he was responsible for the first general inspection of the apothecaries' shops in the provinces, rescuing them to a large extent from the hands of quacks, who often made large fortunes out of the sale of fictitious remedies. As a result of these inspections, he published in Italian two reports on the sale of drugs, and, on the Pharmacopœia, as well as effecting great improvements in the provinces in the study of obstetrics and midwifery.

The fourth volume of *Police Medicine* was published in 1788, and the book was translated into Italian and Dutch. In the spring of 1790, Joseph II. died, and, deprived of this powerful support, Frank fell a victim to the intrigues of the Italian nobility, who resented the authority he possessed as inspector of the hospitals in Lombardy. He was obliged to allow the nobles to take charge of his hospitals until later, a surprise visit from the new Kaiser, restored him his office. "So," said Frank, "at this stage the arrows directed against me had to be put back into the quiver." Later a fresh conspiracy broke out; abusive pamphlets were published accusing him of being an enemy of the State. He kept silence, trusting to receive support from Vienna, but his health was shaken by the anxiety thus caused him. A case was eventually brought up in the Vienna Courts and the verdict went in his favour. He was reinstated in all his offices and his accusers received the just reward of their folly. But now he longed to return to Germany, and only the loyalty of his students, who begged him to remain, kept him in Italy.

In 1795, the Emperor appointed a commission of inquiry to consider what improvements could be effected in military sanitation, and Frank was elected Chairman. On its report, he was offered the post of Director of the General Hospital and Ordinary Professor of Clinical Medicine in the University of Vienna at a salary of 5000 gulden, with a free house and a sum of money to defray the cost of his removal. This he accepted, making the condition that his son Joseph should have a position on the Staff, for he had married again after the death of his first wife and had

two sons. His lectures at Vienna were delivered in Latin. Conditions here were very much below the standard he had instituted at Pavia, and there was no provision at all for clinical instruction. He therefore opened a clinical class in the hospital, and although not obliged to do this by the terms of his appointment, continued it, without fees or reward, save the benefits conferred on his students, all the time he held his Chair. Infectious diseases were quite beyond the control of the hospital authorities, and Frank's son contracted a fever and died. In time, however, the influence of so powerful a personality as that possessed by the new Director, began to make itself felt. The clinical teaching was revolutionised, *post - mortem* examinations, and the study of pathology were introduced, and the appointment of a permanent pathologist secured, not only in the General Hospital, but in all the larger hospitals in the district. A Museum of Pathological Anatomy, where specimens of healthy and diseased organs could be compared, was founded in Vienna. The medical and surgical curriculum was revised, comparative anatomy, physiology and botany being included in the Medical Course. Frank was so far in advance of his time that he recognised the desirability of a closer connection between the veterinary and medical sciences, and initiated a scheme for the comparative study of the diseases of men and animals. He held that every veterinary surgeon should be an experienced doctor, and that the two sciences should keep abreast of each other's work.

In England Jenner's discovery was attracting attention, and with the Emperor's approval, Frank inoculated twenty-six waifs and strays with a cow-pox

virus. Of these children fifteen reacted to the inoculation and became immune to smallpox.

In 1804, disgusted with the political intriguing in Vienna, Frank resigned his Chair at the University, and removed to Vilna and afterwards to St Petersburg, where he held the posts of clinical professor, ordinary-physician, and counsellor of State. In 1808 he sought relief from teaching, in order to devote himself to the completion of the last two volumes of *Police Medicine*, and with the pension he received, retired to his native land and settled in Freiburg. In 1811, however, he was obliged to return to practise in Vienna and there he died in 1821, at the age of seventy-six.

Frank was a great and wise teacher, to whom his pupils were devoted. Of his own teaching he has said: "My pupils did not swear by the words of their teacher, but dubiously and with an anxious desire for knowledge, betook themselves to the sick-bed as to a trusty touchstone." By which method they proved that much which had "been esteemed as genuine gold was but base metal and of bad standard." "And when they had gradually abandoned the profitless swarm of hypotheses, a short time before so highly prized, they became that which I wished them to be, friends of the truth, not of learned ostentation, unwearied and eager for each new ray of light, whatever its source." And one of his pupils, his fellow-countryman who became a famous surgeon, said of him: "No one made so elevating and permanent an impression upon me as J. P. Frank. His teaching fell upon susceptible minds like the moistening dew. We owe to him, not simply the mass of learning which we acquired, but the stimulus to independent investigation."

His chief works are *Epitome de curandis morbis*, which in spite of its six volumes, ran through many editions and was translated into French by Gardereau; and his *System einer vollstandigen medicinischen Polizey*, *A Complete System of Medical Police*, a copy of which in old German is in the Library of the Royal Society of Medicine in London. This great work which placed his name in the front rank of illustrious pioneers in the science of hygiene, will remain, as Baas has truly said, "a monument of his burning enthusiasm in the cause of the welfare of mankind." The subjects which Frank discussed in this work covered such a wide field that they might almost have been written in modern times. School hygiene, meals for school children, suitable benches for their use, midwifery, sewerage and the water supply, the question of the burial of the dead, the organisation of hospitals and many other subjects—all came under his review, and he considered it the duty of the authorities to see that these reforms were carried out by the institution of a medical police.

Frank received many honours from European Universities, and his advice was continually sought by Emperors and Princes. His was not an easy life, for he lived in troubled times; but it was one full of work for the benefit of his fellow-men. In his autobiography he says: "I have often reflected that I could have saved myself a hard and restless life, and slept more quietly in my bed at night, had I followed my father's calling. But then is one born to sleep quietly in bed at night? The little slip of a tree which I planted, as the founder of Police Medicine, has, after not too long an interval, grown to an oak

that spreads its branches over Europe, and bears fruit which I truly had not expected to ripen so soon."

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EDWARD JENNER, M.D., F.R.S.

1749-1823.

Unlike some other illustrious members of his profession, of whom it might be said they adopted it almost by accident, Edward Jenner was marked out for medicine from an early age. His father, the Vicar of Berkeley in Gloucestershire, where Edward was born on the 17th of May 1749, died when the child was only five years old, and his education was undertaken by his elder brother, the Reverend Stephen Jenner. His mother's maiden name was Head, and her father had also been at one time Vicar of Berkeley. While he showed some proficiency in classics, undoubtedly his natural inclinations lay in the direction of Natural History, and Nature herself was for him his first love to whom he remained constant throughout his life. As a boy he was often to be seen wandering alone in those meadows round his home, to which he so often referred in later life as his natural dwelling-place, making collections of all sorts of creatures, and searching for fossils in the woods and countryside. He thus had an early training, self-imposed as it was, in methods of accurate observation which were to lead him eventually to his high destiny, for of Jenner it may truly be said: "He stood between the dead and the living; and the plague was stayed."

One there was who did not fail to mark the

EDWARD JENNER
1749-1823

From the portrait by Northcote in the National Portrait Gallery,
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aptness of the young man for the study of Nature. The celebrated anatomist, John Hunter, at whose house Jenner studied, wrote to him when he had left for the country: "I shall be glad of your observations on the cuckoo and upon the breeding of toads." . . . "If possible, I wish you would remove the cuckoo's egg into another bird's nest and tame the young one, to see what note it has." . . ."See if you can catch the number of pulsations, and the frequency of breathing, in the bat, without torture." . . . "If the frost is hard, see what vegetables freeze; bore holes in large trees and see whether the sap runs out, which will show it is not frozen." And Jenner did eventually write a paper on the habits of the cuckoo, which was published in the *Philosophical Transactions of the Royal Society*, and led to his election as a Fellow of that body in the following year, although there were diverse views as to its merits.

His first apprenticeship was with Mr Daniel Ludlow, a surgeon of Sodbury, near Bristol, and it was here, at the beginning of his career, that his attention was arrested by the remark of a country-woman, who had come to seek Mr Ludlow's advice. When the subject of smallpox was mentioned, she observed, "I cannot take that disease, for I have had the cow-pox." The words made a profound impression on Jenner, and he pondered their significance till they became indeed the clue to all his future work. In his day, as in Sydenham's, epidemics of smallpox raged through the country, wiping out whole families and killing thousands, while those who recovered from this pestilential disease were left disfigured for life. The remedy then in vogue was inoculation, the

communication of smallpox to the healthy to protect them. It was introduced in England by Lady Mary Wortley Montague, who learnt it from the Turks when her husband was Ambassador at the Porte in the first half of the eighteenth century. But the practice was a very old one, reaching back, as Baas has said in his *Outlines of the History of Medicine*, to "hoary antiquity," being practised by the Indians and the Chinese even, it is said, in the era before Christ. In Jenner's day, it was the custom to inoculate those who had not had the complaint with the virus from a patient who had a mild attack; but, before this was done, a drastic process had to be undergone by the unfortunate person presenting himself for inoculation. In Jenner's own words, he was subjected to "bleeding till the blood was thin; purging till the body was wasted to a skeleton; and starving on vegetable diet to keep it so." After all this, he was inoculated with a mild smallpox, but with their powers of resistance so weakened, it is not surprising that many succumbed. And, whatever the result of the inoculation, the victim could not help becoming a further source of the spread of infection. Nevertheless, the chances of escaping smallpox in the ordinary course of events were so remote, that people gladly submitted themselves to this treatment.

In 1770 Jenner left Bristol for London to complete his studies at St George's Hospital, and it was then that he lived for two years in the house of John Hunter as a resident pupil, and became a lifelong friend of that famous man. Under Hunter's tuition, he developed an aptness and skill in dissecting delicate organs, and in preparing and arranging specimens,

that induced the surgeon to recommend him to the President of the Royal Society, Sir Joseph Banks, Sir John Pringle's successor, and Jenner was given the task of preparing specimens brought home by Captain Cook from his first voyage of discovery in 1771. The success with which he accomplished this piece of work resulted in an offer from the President of the post of Naturalist on Cook's next expedition in 1772; but the young doctor's heart was fixed in Gloucestershire, and he preferred to return to practise in his native village, refusing also an invitation from John Hunter to join him in establishing a school for Natural History in London.

The subject of the cow-pox with the possibility of its protective powers against smallpox still occupied his mind. He mentioned it to Hunter and other of his medical friends; but although Hunter occasionally referred to the subject in lectures, little importance was attached to the idea. Jenner, however, was not discouraged. On his return to Berkeley, he would constantly introduce the question at a Medical Society, which, chiefly at his instigation, met at Fleece Inn, Rodborough, for discussion and friendly intercourse. The frequency with which he harped on a topic, considered by his colleagues to be merely country gossip, at last drove them to threaten his expulsion from the club unless he dropped the subject. Now this was all the more remarkable, because Jenner was a man whose companionship was so eagerly sought by his friends that they would often accompany him as he rode through the country on his professional rounds, dressed in a blue coat with yellow buttons and shining top boots with handsome silver spurs, for no other reason than to hear him discourse on

natural history and the wonders of the countryside. Yet for the subject nearest to his heart, his professional colleagues showed the usual antipathy of the orthodox and the unimaginative. Jenner had, therefore, to pursue his inquiry unaided by the encouragement of friends in the small leisure he could snatch from the arduous calls upon the time of a country surgeon. He made also many physiological investigations, his papers being read at the meetings of the two medical societies in the neighbourhood, the "Medico-Convivial" and the "Convivial Medical." His paper on the subject *angina pectoris*, about which little was known, attracted some notice; and another on the relation between rheumatic fever and disease of the heart is said to have anticipated later discoveries, but his claim to this unfortunately cannot be substantiated owing to the loss of the manuscript.

It was not till 1780 that he found himself in a position to communicate the results of his work on the cow-pox, and then only to an intimate friend, Edward Gardner, with instructions that it was not to be published abroad, "for," said Jenner, "should anything untoward turn up in my experiments, I should be made, particularly by my medical brethren, the subject of ridicule—for I am the mark they all shoot at." The *Observations* were written in his own hand and are now in the possession of the Royal College of Surgeons, London. In his researches he had made a careful study of all the varieties of cow-pox, which is an eruptive disease of the cow's udder producing small hollow cysts containing a clear fluid. This fluid will infect the hands of the milker if the skin should happen to be broken, and Jenner observed the different kinds of sores produced on the hands

of dairymaids by milking infected cows. He found that not every form of cow-pox could give immunity from smallpox, and pushed his investigations till he distinguished one variety which conferred immunity from those which did not. But when with infinite labour he had isolated true cow-pox, he found that even this variety sometimes failed to give protection. This calamity appeared at first sight to be disastrous to his theory, and devastating to his high hopes of being the means of liberating mankind from one of its most deadly scourges. But Jenner had in a supreme degree the unconquerable spirit of the true scientist. Inflexible in the pursuit of his goal, he set himself to discover the cause of the irregularity in the cow-pox as a protective agent against smallpox, and he found that in order to afford complete protection the virus of the cow-pox had to be extracted at a particular stage of the disease, about the eighth day. Taken at other periods in the course of the disease, its virtue had gone out of it and it only produced a local effect, sores perhaps on the skin, but was powerless to give immunity from smallpox. Once, however, this protective stage in the history of the cow-pox had been clearly defined, there remained no difficulty in obtaining the virus at the moment when it was most effective. The problem then was solved. In the course of his experiments, Jenner came to the conclusion that swine-pox as well as cow-pox was only a modified form of smallpox, and to prove this, he inoculated his eldest son with swine-pox and found that a subsequent inoculation with smallpox produced no ill effects.

On the 14th of May 1796, Jenner took a lymph from the hand of Sarah Nelmes, a dairymaid, who

had the infection of cow-pox, and with it he inoculated a healthy boy of eight, James Phipps, whose name deserves a place among the immortals, for he was the first on whom regular vaccination was tried. James Phipps developed cow-pox in quite a regular manner, and six weeks later, Jenner inoculated him with the virus of smallpox, and the boy remained quite well. He was immune. This success must have seemed to Jenner repayment a thousandfold for all his labours. He could now envisage a world freed from one of its deadliest horrors. It was his intention to send his *Observations* to the Royal Society, "but," says Dr Baron, his biographer, "when the subject was laid before the President, (Sir J. Banks), Jenner was given to understand that he should be cautious and prudent; that he had already gained some credit by his communications to the Royal Society, and ought not to risk his reputation by presenting to that learned body anything which appeared so much at variance with established knowledge, and withal so incredible."

It remained then for Jenner, as for Lister nearer our own times, to demonstrate by practical experiment the truth of his discovery. He published in 1798, his paper under the title, *An Inquiry into the Causes and Effects of the Variolæ-Vaccinæ, a disease discovered in some of the Western Counties of England, particularly in Gloucestershire, and known by the name of Cow-pox*, and he went to London intent on converting the medical world to his views. But, to his great disappointment, no one could be found to allow himself to be inoculated with the virus he had brought with him for the purpose, and after a few months he returned to Berkeley, having handed over his virus to Mr Cline, a celebrated surgeon of the day, at

St Thomas's Hospital, in case any suitable patient should present himself for experiment. Mr Cline inoculated a child suffering from hip-disease partly to make a counter-irritation and not solely for the purpose of producing immunity from smallpox, but afterwards, the child was inoculated with the virus of smallpox and did not develop that disease. This case attracted much attention in medical circles, and many more experiments were made with success. Mr Cline tried to induce Jenner to return to London and assured him that if he would set up in practice there, it would bring him in an income of at least £10,000 a year; but Jenner refused, preferring still the quiet of the country where he had spent his life.

Once the doctors had taken the matter up and proved the success of vaccination, society became interested. A Mr Hicks, we are told, had his two children vaccinated, and Lady Frances Morton "risked the life," as she thought, of her only child. The children of King William IV. were vaccinated, and, in spite of much opposition from many quarters, the practice spread. In 1802, a petition was presented to Parliament asking for a grant to recompense Jenner for the loss of much of his practice which the work in connection with vaccination had entailed. The opposition raised in the House to this grant greatly distressed Jenner who said that "he wished the business had never been brought forward. It makes me feel indignant to reflect that one who has, through a most painful and laborious investigation, brought to light a subject that will add to the happiness of every human being in the world, should appear among his countrymen as a supplicant for the means of obtaining a few comforts for himself and his family." The House,

however, voted the sum of £10,000, and, at a later date, another sum of £20,000.

The opposition against vaccination was carried on until quite recent times and often excited violent disputes. It was only partially set at rest by the findings of the Royal Commission on Vaccination in 1896; and Mr Bernard Shaw in our day took full advantage of the passions this question aroused in the public mind to ridicule the great discoverer. Had Jenner known that the immunity conferred by vaccination would in time wear off and revaccination be required, much angry altercation might have been avoided. But this knowledge was not acquired till Jenner had been half a century in his grave. "When," says Claude Kerr in his work on vaccination, "vaccinated persons in after years began to contract the disease, doubts were naturally cast upon the merits of the procedure. If from the first the necessity of revaccination after a certain time had been understood, it is unlikely that the question would ever have caused the acute controversy which has raged more or less since its introduction." "But to Jenner," he says again, "the whole credit of the discovery must be given, for it was he who first scientifically studied the question, and who brought the results of his experience before the public."

Many honours were conferred upon Jenner. He had interviews with the King and Queen and the Prince of Wales, whose interest in his discovery gave a great impetus to the spread of vaccination. The Empress Dowager of Russia sent him a diamond ring, and endowed the first child to be vaccinated in Russia with a pension for life, giving it the name of "*Vaccinoff*." He received the gold medal of the

Medical Society in London, and as before mentioned, he had been since 1788 a Fellow of the Royal Society; the Physical Society of Guy's made him their first Honorary Associate; and in 1813 the University of Oxford made him Doctor in Physic by a decree of the convocation. When he received this diploma, Jenner remarked: "It is remarkable that I should have been the only one of a long line of ancestors and relations who was not educated at Oxford. They were determined to turn me into the meadows, instead of allowing me to flourish in the groves of *Academus*. It is better, perhaps, as it is, especially as I have arrived at your highest honours, without complying with your ordinary rules of discipline." Foreign academies and learned societies decorated him with their honorary degrees, and his name became famous all over the world.

The Royal Jennerian Society was founded in 1803 for the supply of lymph and free vaccination for the poor, until in 1806 internal dissensions in the management led to its being closed down. Its place was taken by the National Vaccine Establishment in 1808. In 1840 an Act of Parliament provided for the payment of vaccine fees out of the rates, but vaccination was not made compulsory in England till 1853. In this reform the small country of Bavaria anticipated us by over forty years, for vaccination was made compulsory there in 1807. The provision of the lymph to send abroad occupied a large part of Jenner's time, and entailed so much correspondence that he named himself "Vaccine Clerk to the World." So popular was his name in society abroad, that when war broke out with France, Jenner was asked to petition Napoleon for the release of some of his countrymen who had

been detained in that country, among them, Dr Wickham, a travelling Fellow of Oxford University. Napoleon's feelings were anything but amiable towards Englishmen at the time, and when the petition was brought to him, he pushed it roughly aside. "But do you see," said Josephine, who was with him, "Do you see from whom this comes—Jenner?" And immediately Napoleon changed his tone. "What that man asks," he said, "must not be refused," and the petition was granted.

In 1815 Jenner suffered a great grief by the death of his wife. His marriage with Miss Catherine Kingscote in 1788 had proved a very happy one, and he felt her loss severely. She left two sons and one daughter. Soon after her death he went into retirement in the country, living quietly at his house, The Chantry, close by the church. In 1820 he was seized with a fit of apoplexy from which he made a temporary recovery; but another fit overtook him in 1823, and he died on the 26th of January in the seventy-fourth year of his age. He was buried in the Parish Church of his native village, Berkeley, that he loved so well.

There is a statue to his memory in Gloucester Cathedral, and his portrait by Northcote, said to be an excellent likeness, reproduced here by kind permission of the authorities, is in the National Portrait Gallery in London. But his true memorial is to be found on the arm of every baby born in England to-day, and in every civilised country of the world.

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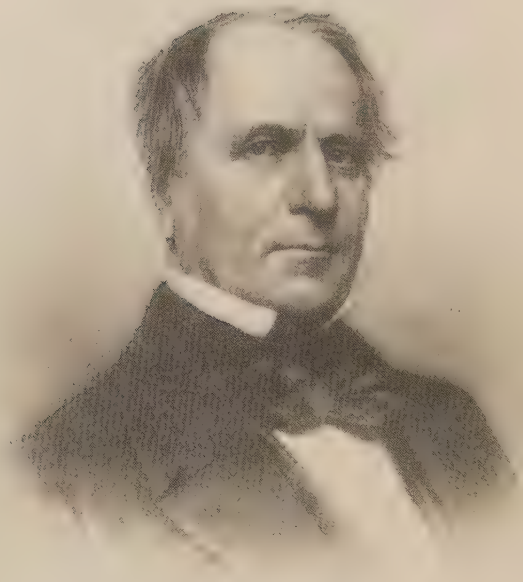

Lemuel Shattuck
1793-1859

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LEMUEL SHATTUCK.

1793-1859.

In a "Memoir of Lemuel Shattuck," published in the *Proceedings of the Massachusetts Historical Society* in 1880, the writer, Charles Hudson, says: "If a man becomes learned in spite of embarrassments, it shows that he has native ability and force of character, which the college student may or may not have. But there is danger that he may get into ruts, when he is compelled to stop and turn back or rush on to destruction." The subject of the memoir, in spite of the embarrassments of a scanty education, neither got into ruts nor rushed to destruction. Rather he rose to fame and occupied many important public positions. He has been called the Chadwick of America, for, like Chadwick, a layman, he was the true founder of Public Health work in that country, and the record of his accomplishments, in spite of the limitations of his education, fully justifies the title.

Lemuel Shattuck, the son of John Shattuck and his wife Betsy, was born at Ashby, Massachusetts, on the 15th of October 1793. He himself has traced his long descent from William Shattuck, a Puritan, who was born in England in 1621, emigrated to America in 1642, and settled in Waterton, New England, where he became a landowner, and where he died in 1672. Of William's ten children, John, who was drowned in Charles River on a journey from

Boston to Charlestown, was the direct ancestor of Lemuel by his marriage with Ruth Whitney, a member of his own faith. Lemuel was therefore a thorough Puritan by inheritance, as he himself has noted in the memorials of his family. In his autobiography, he says that he never had the benefit of much public instruction, for the common school in the district where he lived was some distance from his home, and the teaching there was imperfect and spasmodic. He seldom attended more than five or six weeks in one season, and had it not been for the instruction he received at home from his elder brothers and sisters in the little leisure time their busy lives allowed, he would have fared badly. For the rest, to use his own words as he tells the story in the third person, "Two quarters in the Academy completed his public education. Whatever knowledge he has possessed besides, has been acquired almost entirely in his private study, by his own unaided efforts, at such times as could be spared from actual labour and business, or from sleep. And he has great satisfaction in stating as the result of his own experience, that any person, by having a judicious plan for saving the odd moments of life, and appropriating them to reading good books, or the acquisition of useful information, may obtain a large fund of knowledge, which will be a qualification for greater usefulness in any station, and be the source of great gratification and happiness in more mature and declining life."

Not everyone is capable of using to such good purpose the "odd moments of life," nor can it be denied that it needs something of genius to build, as Shattuck did, on so simple a foundation, so lasting a fame. One who was his contemporary, a member of the New England

Historic-Genealogical Society of which Shattuck was a founder, has said: "My earliest recollections of him carry me back to the days of childhood, to the hills and streams of my native town, its institutions and people. I remember his parents, their quiet simple habits of life, cultivating their farm, with no ambitious views or aspirations for notoriety or wealth, and only wishing to be useful in their day and generation."

Shattuck lived at New Ipswich, New Hampshire, until 1815, and then, in order to follow the profession of a teacher, he moved to Troy and later to Albany. He had always had a lively interest in education, for to him the subject was "as broad as the capacity of the human mind," and by choosing this career he hoped to obtain a knowledge of men and things, and still have time for private study. He taught in New England, New York, and Michigan, and was responsible for establishing in Detroit the first Sunday School that Michigan State had ever possessed, superintending it himself for four years. After a period of teaching in the district schools, he settled in Concord, Massachusetts, in 1823, and, possibly with a view to his marriage, took to trade. In 1825 he married Miss Clarissa Baxter, daughter of the Hon. Daniel Baxter, by whom he had five children. During the ten years spent in Concord as a merchant, he still devoted much of his time to teaching and other public activities, for, says Mr Hudson, "his mind was too active, and his aspirations were too broad to be satisfied with weighing out sugar and tea by the pound, and measuring off bombazine, nankeen, or tape by the yard." As a member of the school committee in Concord, he "reorganised the public schools in that town, introduced a new system for the

division of the public school money, and prepared and printed a new code of school regulations." (The words are his own.) He was responsible for the introduction of a school register, and recommended that it should be given to the teachers at the beginning of the school term, and returned to the committee at the end, and that the committee should make written reports annually to the town concerning the schools. Such a report he himself prepared and published and presented to the town in 1830. It was the first annual school report Massachusetts had ever known. Up till then it had not been considered imperative on school committees to give any account of the matters entrusted to them. Finally, this practice was adopted by the legislature and became law in 1838. "It may with perfect confidence be said," says Shattuck, "that no measure, aside from the establishment of the Board of Education itself, has done so much for the improvement of the public schools of the State."

In 1833 Shattuck moved to Boston, and started in business as a publisher and bookseller, and in 1835 published a *History of the Town of Concord, Middlesex County, Massachusetts, from its earliest settlement to* 1832. This work was remarkable at the time of its publication as being one of the first histories of its kind, and for the broad view its author took of the part local affairs play in relation to the State. It was not merely a parochial account of what happened in Concord. It viewed the town as a unit in the larger community of the State, and interpreted local events in regard to the future of the nation. For this reason Shattuck always laid great stress upon the value of keeping records, and if he has been likened to Chadwick for his advocacy of public health, he may also be

compared with that far-seeing sanitarian and statist, William Farr, who gave England her model system of registration.

In Boston, Shattuck was a member of the City Council and for some years a representative of the city in the legislature, and there was hardly any public measure of importance brought up in which he did not take an active part. His work on the registration laws, both of the State and of Boston, proved of great value to the nation. In 1841 he published *A Complete System of Family Registration*, containing charts, forms and directions for registering the birth, marriage and death of the various members of a family. In this work he devised a plan for a more efficient system of keeping private and public records in order to obtain precise statistics of persons and families, the public records of his time being in a most neglected state. The same year appeared a laborious work entitled *The Vital Statistics of Boston*, "containing an abstract of the bills of mortality for the last twenty-nine years, and a general view of the population and the health of the city at other periods of its history." And in 1843 he published two papers with the quaint titles, which explain their purpose, *The Domestic Bookkeeper and Practical Economist*, "suggesting how to live independently, and how to be independent while we live," . . . "designed for those who are willing to know how they live and who desire to live better"; and *The Scholar's Daily Journal* . . . "for exhibiting at one view, the attendance, character, and intellectual progress during each month; embracing introductory suggestions and rules of behaviour for good scholars." These were followed by a *Report on the Census of Boston* for the year 1845, and *The*

State Library. In 1848 and 1849, stung by the neglect of the registration laws, he presented two papers to the legislature, the first being entitled, *Memorial of Lemuel Shattuck, praying for the revision of the laws in relation to registration.* His efforts to reduce the public debt and to secure an economical administration of city government were unrelenting, and to rouse the indifference of the public to the neglected state of the public records, he wrote articles for the press, returning to the subject again and again, till the inquiries thus set on foot resulted in a petition to the General Court by the American Academy of Arts and Sciences and the Counsellors of the Massachusetts Medical Society for the provision of a law for the registration of births, deaths and marriages, such as had been established in England by the Births and Deaths Registration Act of 1836. In 1842 such an Act was passed and the registration system of Massachusetts became a model for all other states. The Act provided for returns to be made to the Secretary of State, who was required to prepare "such tabular results as will render them of practical utility." Shattuck was responsible for parts of the first and second annual reports thus made, and the fourth report was written entirely by him. An effort was now made by his supporters to appoint him to the office of City Registrar, but it failed to secure a majority of the votes of the Council.

In 1849, at the suggestion of the American Statistical Association, of which Shattuck was a member, the legislature appointed a Sanitary Commission "to prepare and report to the next General Court a plan for a sanitary survey of the State, embracing a statement of such facts and suggestions

as they may think proper." Of the three commissioners appointed Shattuck was the chief, and his the master-mind. He resembled Chadwick in this, that on the many commissions of inquiry on which he sat, his industry, his insight into the needs of the case, and his capacity for work so far surpassed anything that his fellow commissioners were capable of, that the bulk of the work fell on his shoulders. He was mainly, if not entirely, responsible for the report of this commission, a document of 500 pages. It treated of the subject of public health exhaustively, tracing the measures that had been adopted in Greece and Rome, in the principal states of Europe, and in England, for purer water supplies, drainage, the treatment of diseases, the prevention of the spread of epidemics, and all such laws for the improvement of the people's health. It gave a full account of what the State had done, and detailed plans of what it ought to do, and suggested the appointment of a State Board of Health. On its publication, some of the medical journals greeted it with high praise; the *New York Journal of Medicine* of March 1851, referred to it as "an epitome of sanitary science," and said: "We doubt if there has appeared any work for many a year in our country that is of more real interest to the community than this, whether we regard it as replete with suggestions for the promotion of personal health, or as a great political document intended to show the mode whereby the physical and intellectual powers of a people may be fully developed." Nevertheless, its recommendations were ignored. "It fell still-born from the State printer's hands," as Dr Bowditch aptly remarked in a lecture on "Public Hygiene in America," delivered before the International

Medical Congress, Philadelphia, in 1876. In the course of this address he said: "I remember Mr Shattuck well. Calm in his perfect confidence in the future of preventive measures to check disease, he walked almost alone the streets of his native (adopted) city, not only unsustained by the profession, but considered by most of them an offence, for his earnest advocacy of what seemed to the majority of us physicians to be out of a layman's sphere, and, withal, of trifling moment, compared with our usual routine of so-called 'practice.' The public, ignorant of hygiene, treated him no better."

This reception is scarcely surprising when we remember that when Chadwick was born in England at the beginning of the nineteenth century, the subject of public health was not generally looked upon as the province of the legislature, and although British medical practitioners were beginning to lead the world in sanitary science, they were not yet given positions of authority from which they could enforce protective measures against disease. In every European country the concern for public health was only brewing below the surface of current events, brought to the top from time to time by the efforts of far-sighted men or the writings of philosophers. In England, Jeremy Bentham's work was slowly preparing the ground for a change of view in public opinion, and he lived to see Chadwick arise to carry on his task. But, even as late as 1870, Sir William Gairdner, a famous Health Officer of Glasgow, writing of the deplorable conditions of that city, had to admit that remedies waited upon the state of public opinion. In one of his reports, he says: "I may say our difficulty has been all along the fear that our position is not

sufficiently secure—the fear and the certainty, indeed, that we could not propose, with any chance of carrying public opinion with us, measures of the extremely strong and radical order that are absolutely necessary to cope with the immense evils we have to deal with. Till we have public opinion with us—and this is not only having the arm of the law, as represented by the authorities, with us, but the large concurring force of public opinion—till then, I believe, we shall be too weak to cope with the evil." And his successor, Dr James Russell, in his history of *The Evolution of Sanitary Administration in Glasgow*, 1800-1854, draws a parallel between physiological means of measuring the time which elapses between thought and action and local Government history as an instrument for the same purpose. He says: "By refined methods physiologists have been able to measure the intervals which elapse between the stages of perception and volition in the brain" and the action which follows. "This history gives us many opportunities of measuring in like manner the inertia of the civic mind by noting the length of time which intervenes between the clear formulation of a policy and its adoption. In 1842, there was published a report on the legal provisions available in Glasgow for the removal of Nuisances. . . . It was twenty years before the idea was carried out." Shattuck was one of these far-seeing reformers, the true significance of whose work is never realised till a later generation has sprung up to reap its fruits. Though his suggestions were not adopted at the time, his work served to educate public opinion to his view that the State has a moral claim upon every one of its citizens, each of whom must bear his share of

responsibility if the conditions that prevail in his township, or countryside, are not such as should be tolerated by an educated nation. As Sir William Gairdner has said: "Although it is not possible to 'make men moral by Act of Parliament,' yet as regards the external conditions of their life, their environment . . . it is almost all important, and at all events it is very possible, so to guide both legislation and the ideals of public service as to an almost indefinite extent to influence the habits of great numbers of men." Twenty years after the publication of the Report of the first American Sanitary Commission, the Secretary of the Board of Health of Massachusetts, Dr Derby, based a number of his plans for the improvement of the public health on the recommendations laid down by Shattuck, and it was found that so widely had the latter viewed the whole subject, that very little could be added in the way of betterment.

To the preservation of public records, Shattuck had always attached great importance, and most of his works bear upon this subject to some extent; but his greatest genealogical effort, a work on which he must have expended infinite labour, is contained in a history of his own family, bearing the title, *Memorials of the Descendants of William Shattuck, the Progenitor of the Families in America that have borne his name: including an introduction and an appendix containing collateral information.* It was published in 1855, and in writing this he was a pioneer in genealogy, for the subject had been neglected in America as being tainted with tradition and authority, and was even scorned in the middle of the nineteenth century. In this book the history of his family is traced from

the first emigrant to his own day, and the period covers the lives of six or eight generations. It was a work from which Mr Hudson says "most men would shrink in despair." It extended to 414 pages, giving a detailed account of each generation which practically amounted to a history of the times. Mr Henry Carey, writing in the *Principles of Social Science* in 1859, described it as, "Perhaps the most remarkable contribution to Vital Statistics that has yet been made," and Mr Hudson pointed out in his biographical sketch of Shattuck, "When he wrote that important and interesting work he had little or nothing to guide him in his plans; he was a pioneer in a great measure in exploring this untrodden wild." This was the last important work Shattuck produced, for his life was drawing to its close. In 1856, indefatigable in pursuance of his idea of the value of records, he published *Blank Book Forms for Family Registers devised and constructed upon a new, simple, and comprehensive plan.*

He died on the 17th of January 1859, in his sixty-sixth year. His was not a long life as measured by the quickly-vanishing standard of three score years and ten; but if reckoned by the multitude of his activities it far surpasses that of most men, for it was full to overflowing of unstinted labours on behalf of his country. The portrait of him which accompanies this sketch is reproduced from the engraving in the *New England Historical and Genealogical Register* in the Forbes Library, Northampton, Mass., by the courtesy of the *New England Historic-Genealogical Society.* It bears out Mr Hudson's description of him as one who possessed "a cool, deliberate mind, of more than ordinary strength and self-reliance . . ."

and who, "when he had formed a resolution, would not relax his effort till the object was attained."

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Sir Edwin Chadwick
1800-1890

From a photograph, reproduced by permission of the Royal Society of Tropical Medicine and Hygiene.

SIR EDWIN CHADWICK, K.C.B.

1800-1890.

"By the most evident and thoughtless omission, we permit our health to be blasted by the silent and insidious, yet sure precursors of disease, and never sufficiently appreciate its comforts till we have irremediably lost it. . . . Let our means be what they may, without health they purchase only ennui." Thus Dr Roberton, an Edinburgh physician, pleaded for some measure of preventive medicine in his book on *Medical Police* in 1809, and nearly twenty years later an article appeared in the *Westminster Review* entitled, "An Essay on the Means of Insurance against the Casualties of Sickness, Decrepitude, and Mortality," in which an unknown writer described ennui as "the disease of unfurnished minds," and proceeded to such a review of the health of the nation and the means by which man's spell on earth might be prolonged, as to provide all serious thinkers with food for thought for some time to come.

The unknown writer was Edwin Chadwick; his essay, the foundation of sanitary science in England.

Edwin Chadwick's grandfather, Andrew Chadwick of Longsight, near Manchester, was a man of great strength of character and of some local fame. A friend of John Wesley, and a great supporter of his views, even to the extent that he refused to put by money or to buy land which would increase in value,

because to do so was to accumulate riches and therefore a sin in the eyes of the founder of the Methodist faith. He had a son James, of totally different temperament, a musician and a lover of natural history, who taught botany and music to John Dalton, the physicist, and afterwards became editor of the leading Liberal paper of the day, *The Statesman*, during the imprisonment of its editor for political libel. Edwin Chadwick, his celebrated son, was the child of James's first wife, who died young while he was quite a boy. He was educated at the village school in Longsight and, later, at a boarding school in Stockport, until, when he was ten years old, his family moved to London, and there he received private tuition, learning French, Italian, and Spanish, in which he became proficient.

About the age of fifteen, he was apprenticed to an attorney's office, and eventually entered as a student at the Inner Temple. To augment a scanty income while studying for the Bar, he wrote reports for the *Morning Herald*, until one day his attention was called to a statement, made before a Parliamentary Committee by the Government Actuary, to the effect that in spite of the improvement in the conditions of life of the middle classes of England, there was no corresponding improvement in their expectation of life. The accuracy of this statement, made by a Government authority, seemed questionable, and Chadwick undertook to investigate the facts. The publication of his article on the "Means of Insurance," in the *Westminister Review*, was the result, and his finding was contrary to the Actuary's statement, and led him to the conclusion that the life of the middle class had lengthened with their better surroundings. The

article attracted much attention among social reformers and economists, including Grote and John Stuart Mill. Chadwick was twenty-eight when he wrote it. He admitted that when he undertook the labour, he was chiefly interested in the results of his calculations; but as the work proceeded, there formed in his mind the nucleus of a new science, of what he himself called the "sanitary idea," the idea, not common in 1828, that disease and death were not inevitable, but were dependent upon conditions which, by a knowledge of first principles, man might control, thereby prolonging his life to its natural span. This became the leading motive of Edwin Chadwick's life, and one which lay at the root of all his social work.

In 1829 Chadwick published an essay on "Preventive Police" in the *London Review*, and an essay on "Public Charities in France." In the former, he not only recommended the provision of a protective force which would prevent crime, but one which would be the means of procuring an accurate record of the state of the country. Jeremy Bentham, then in his eighty-second year, happening to see the article, was so delighted to find a young man so much in sympathy with his own life's work, that he sought out Chadwick and obtained his help in the completion of his last work, *The Adminstrative Code*, even offering to make him independent if he would undertake to become the expounder of the Benthamite philosophy, an offer which Chadwick, while appreciating the distinction the suggestion conferred on him, declined. Until Bentham's death in 1832, Chadwick lived with him at his house in Queen's Gate, working at *The Administrative Code*, continuing his studies for the Bar and pursuing his inquiries into the conditions

among the poor in London, in the course of which he contracted a typhus fever from which he very nearly died.

In 1830 he was called to the Bar. For two years he hesitated about his future career, for the law had attractions for him and held out the promise of success. His enormous capacity for work, assisted by a naturally strong constitution, his excellent memory for facts, and the speed with which he could grasp the essentials of a situation, together with his calmness in debate, would undoubtedly have carried him far in the legal profession, but against this he had to set the intense interest that the birth of the "sanitary idea" had awakened in his mind. Jeremy Bentham had left him a legacy which eased his financial situation, but his future was still undetermined when, in 1832, the Government appointed a Commission to inquire into the poor law system in England, and offered him a post as one of the assistant commissioners, whose duty it was to visit the different parts of the country and report on local conditions. He accepted the position and gave up the Bar. On the Poor Law Commission were eight commissioners, among them the Bishop of London, Bishop Blomfield, of whom Chadwick's biographer, Sir Benjamin Ward Richardson, has said: "had he, by fate, entered the House of Commons instead of the Church, he would perchance have given England such a Prime Minister as she had never seen before," such was his strength as a ruler of men and his administrative zeal. To him Chadwick was much indebted in his future inquiries into the life of the people.

The results of Chadwick's first year of work as Assistant Commissioner had given him such an

insight into the conditions prevailing in the administration of the poor law, and so thorough a grasp of the measures necessary for reform, that in 1833 he was promoted to the rank of a Chief Commissioner. He had now more authority in directing the deliberations of the Board; but he continued as before to make personal investigations, and by his industry in collecting facts and his direct contact with those who administered the poor law, he put himself in a strong position with his fellow commissioners. Under the existing system, there were 16,500 local administrations of government. To replace these, Chadwick proposed the formation of larger administrative areas, and the appointment of responsible paid officers under a central Board. Even among the commissioners there was much opposition to his scheme for the supercession of the local administrators by paid officials, and still more in the House of Commons; and, although his plan for the institution of the union as the area of administration was embodied in the new Poor Law, Chadwick always maintained that the reform was fatally marred by the rejection of his proposals for centralisation and for the appointment of salaried officers. His designs of instituting industrial schools for destitute children, where they would have been well-fed, clothed and educated to useful trades, almshouses for the aged, and asylums for the mentally deficient, were none of them included in the new Act.

Following the inquiry on the Poor Law, an attempt was made to introduce a Ten Hours Bill for the protection of children employed in factories, and in 1833 the Government appointed a Royal Commission to report on the conditions in factories. Chadwick was appointed one of the three

commissioners, and he prepared the instructions for carrying out all local inquiries, and drafted the report within six weeks from the time the Commission first sat. Government inspectors of factories were appointed as a result of the Commission's report and, later, this system was extended to prisons, mines and workshops. To secure to children engaged in factories some measure, however slight, of education, Chadwick proposed that every child employed should produce a certificate from a qualified school teacher, showing that it had attended school for three hours daily in the preceding week. The House of Lords refused to pass these regulations on the ground that they were the thin edge of the wedge towards a system of universal national education, and Chadwick then introduced them by means of the Poor Law into the schools for destitute children, where their advantages soon became so manifest that further reforms could not be long delayed.

The Report of the Poor Law Commission was presented in February 1834, and the Poor Law Amendment Act, embodying some of its recommendations was passed in the following August, Chadwick being appointed to the office of Secretary to the new Poor Law Board. The new law was described as tyrannical by many, but in the opinion of Lord John Russell the measure "saved the country from great social evils, if not absolutely from social revolution," and he added that, "in labouring for the improvement of the administration of the funds for the relief of the destitute and the prevention of pauperism, for the improvement of the public health and the physical condition of the population, and for the prevention of excessive sickness and mortality, there was no one

to whose zeal and assiduity the country is more indebted than to Mr Chadwick." But Chadwick, whose administrative skill and forceful personality were greater than those of any of the commissioners, found his position as Secretary full of difficulties. He may have been wanting in tact, but he had what his biographer describes as the secret of his success, "the faculty of seeing in any reform that he is contemplating what, under existing conditions, may be at once judiciously and effectually removed, and what may be judiciously and safely left as the basis on which to lay a structure entirely new." He had constantly to point out to the Board where it deviated from the law, and when his warnings went unheeded, he appealed to the Minister, Lord John Russell, who upheld the Secretary's view. This did not make for his popularity with the commissioners, and when, on the resignation of two of their number, two more were appointed who were strongly opposed to the Secretary, Chadwick was forced to take a subordinate place, acting merely as reporter of the Board's actions. He fullfilled all his duties with scrupulous care, and bided his time.

In 1838 an appeal was made by the authorities in Whitechapel to the Secretary of the Poor Law Board for assistance in contending with an epidemic which was raging in the East End. Chadwick persuaded his Board to appoint a medical inquiry, and thus the first Sanitary Commission, composed of Dr Neil Arnott, Dr Kay, afterwards Sir Kay Shuttleworth, and Dr Southwood Smith, came into being. The appointment of the Commission and its report, especially the independent supplement added by Dr Southwood Smith, in which he minced no words

in his description of the disgraceful state of the water-supply and drainage in the first metropolis of the world, attracted great attention. Seven thousand of the reports were printed and distributed amongst the people.

For some time past there had been an agitation by dissenting bodies to procure the registration of births, marriages, and deaths by the State, and not solely by the Established Church, as was the custom. A bill was introduced to this effect. Chadwick saw at once the advantages that would accrue by the addition of a clause in this bill for certifying, not only deaths but the cause of deaths, by which means a reliable record of all diseases would be established and the foundations of true vital statistics laid. He proposed this to Lord John Russell, but that Minister failed to grasp the significance of the idea and gave him no encouragement. Chadwick then approached Lord Lyndhurst, who introduced the clause into the bill in the House of Lords with such success that it passed the Commons without opposition. By the provisions of this clause, registrars were elected by the Guardians, and the qualified medical attendant of the deceased was responsible for recording the cause of death, as is the case to-day. The Births and Deaths Registration Act became law in 1836 and, with it, the General Register Office came into existence; and the need for skilled and scientific assistance in the compilation of statistical tables led to the appointment of Dr William Farr as Compiler of Abstracts. Nothing could have been more fortunate for the country than the choice of this most distinguished man. By his life's work in creating a national system of vital statistics, our General Register Office became the

model for all civilised countries, and just as Pasteur in his Paris laboratory, by the examination of a sample of blood, could diagnose the disease of a patient far away, so the Registrar-General in his office in London had only to consult his official returns to give an accurate report of the nation's health in any part of England.

The evidence which Chadwick gave in 1833-34 before the Buckingham Committee on drunkenness, in which he showed that the national expenditure on drink was five times that of the poor-rates, caused some to place him in the ranks of the temperance reformers. He himself, however, pointed out that his evidence was based, not on opinion, but on the facts which had come to his notice in his work on the Poor Law Board. The appointment of this Committee, the first of its kind, was so novel a procedure that it was greeted with derision by the Commons. It was said a proposition to turn St Stephen's inside out would be just as likely to meet with support. Chadwick in his evidence especially protested against the system of paying navvies at long intervals of time, more particularly those large numbers engaged in laying the new rail-roads. This led to the introduction of weekly payments and removed the temptation to spend in drink the wages accumulated over many weeks.

In 1838 three commissioners were appointed, of whom Chadwick was one, to inquire "into the best means of establishing an efficient constabulary force in the countries of England and Wales with a view to the prevention of offences." Their report was presented in 1839, and it developed the idea, so ably put in Chadwick's early essay on *Preventive Police*,

"Get at the removable antecedants of crime, and crime will be vanquished." Not all the Commission's recommendations found their way on to the Statute Book; but as a record of the possibility of preventing calamity in preference to curing it, the report left its mark on public opinion, and all the more so because, as Professor Masson of Edinburgh remarked, parts of it were as interesting as a novel by Dickens.

In the year 1839 Chadwick married Miss Rachel Dawson Kennedy of Ardwicke Hall, Manchester, and settled down in Stanhope Street, Hyde Park Gardens. To her Sir Benjamin Ward Richardson dedicates his book, *The Health of Nations, A Review of the Works of Edwin Chadwick*, with complimentary reference to her "talents and virtues," but there is otherwise no mention of the part she played in Chadwick's life. They had one son, who became a sanitary engineer of some distinction, and one daughter.

In August 1839 the Poor Law Commissioners received instructions to report on the sanitary conditions of the labouring classes in England, and this work occupied the Secretary of the Poor Law Board until the summer of 1842. This now famous report on the *Sanitary Conditions of the Labouring Classes of Great Britain* has been described as one of the most original works of scientific literature and one of the most important in the field of preventive medicine. It did not bear Chadwick's name, but in it the Commissioners stated that it had been prepared by their Secretary, and it was understood that they did not wish to be responsible for the conclusions of their Secretary in a work so unfamiliar to themselves. Certainly the contents left no doubt as to its authorship in the minds of the discerning. It discussed

the conditions prevailing in working-class dwellings where disease was most prevalent, the bad ventilation in places of work, the comparative chances of life in the different classes of the community, the financial losses caused by the neglect of sanitary measures, the effects of preventive measures in raising the standard of health and chances of life, the state of the existing law for the protection of the public health, and common lodging-houses as centres for the propagation of vice and disease. It was due to Chadwick's repeated denunciation in this report and in many which followed, of the prevailing methods of drainage that improvements were eventually effected, and competent engineering skill employed in removing the refuse of London. Ten thousand copies of the report were sold and distributed to the public. By it Chadwick's name is chiefly remembered and it marked the crowning point of his career.

The next inquiry to which his energies were directed related to burials in the overcrowded churchyards of cities, a matter which had assumed such grave proportions as to be highly dangerous to the public health. His report, entitled *Interments in Towns*, was published in 1843 as a supplement to the report on the *Sanitary Conditions of the Labouring Classes*, and resulted in the establishment of cemeteries outside the towns and the closing of many graveyards.

The efforts of these pioneers in hygiene were greatly encouraged by Prince Albert, who never failed to lend his influence in support of any important step respecting the health of the nation. Sir Robert Peel, too, lent a ready ear to Chadwick's advice, and was responsible for the appointment of a Sanitary Commission to investigate the health of the nation

a commission over which the Duke of Buccleuch presided. Although Chadwick was debarred by his official position as Secretary to the Poor Law Board from serving on it, his advice and assistance were largely sought and gladly given, in the preparation of the report which appeared in 1844. Its recommendations gave great grounds for hope that legislation for the improvement of sanitation would soon be introduced. In the meantime a small event, which had disastrous results for the Poor Law Board, occurred. Some paupers in Andover Workhouse quarrelled about the possession of marrow contained in bones which they had been set to grind down. The doctor of the workhouse brought some charges against the master, and an assistant commissioner was sent down from London to look into the business. The master of the workhouse resigned, but the assistant commissioner was dismissed by the Poor Law Board. The Member for Andover then asked the Commons to appoint a Committee of Inquiry, whereupon he was told by the Minister responsible that a mere workhouse squabble in the south of England ought not to interrupt the serious considerations of the House on the Corn Laws. The House, nevertheless, divided, and the Minister was defeated. At the Committee of Inquiry which followed, Chadwick gave evidence against the Poor Law Board, stating that he had repeatedly brought to their notice abuses in the administration of the Poor Law, but that such representations were "distasteful to those to whom they were addressed." The Board was dissolved and the Secretary lost his post.

He had no official occupation, till in 1847 he was appointed to a Commission of Inquiry into the sanitary

state of London. His urgent recommendations for the introduction of a new system of drainage were not then adopted; but again his report awakened the public to the dangers of their position, and an outbreak of cholera which soon followed did not subdue the alarm of the people. Pressure was exercised, and the sewers of London were taken out of the hands of the local authorities and put under control of a new body, designated the Metropolitan Local Management Board. Chadwick's services were recognised in 1848 by the award of the C.B., a distinction which had hitherto been reserved for the military.

In 1842 the first Board of Health was established, as recommended by the Sanitary Commission report. Chadwick was appointed a Commissioner along with Lord Carlisle and Lord Shaftesbury, and later, when they could no longer do without medical advice, Dr Southwood Smith was added to their numbers; but Chadwick was in effect the Board of Health, and the policy pursued till 1854 was his. The Act establishing the Board limited its duration to five years, and in 1854, after a long debate in Parliament, in which Chadwick's masterly designs came in for a good deal of abuse, the Government was defeated on a proposal to renew the Act and the first Board of Health came to an end. Many of Chadwick's proposals for the improvement of the water supplies, drainage, etc., and the better administration of the Poor Law had been opposed by the vested interests concerned, and he had in consequence many enemies towards whom he never adopted a conciliatory attitude. The feeling against him at the time was very bitter, and it was said that he was an injudicious administrator, and in his zeal for amendment of the public health swept aside the

views with which others regarded his propositions. He hoped to achieve in a few years, says Sir John Simon, the "results which not ten times his few years could see achieved; where others were hanging back, his ardour seemed ready to undertake the work of all." "As the credit of having originated the Board of Health had been due to him, so to him was ascribed, with every depreciative term, the policy which had brought it to an end; and Mr Chadwick bore in those days the distinction which has been many a reformer's crown of laurel, that he was among the best-abused men of his time. With his rare abilities as an initiative investigator in matters of social pathology, and with his absolute rectitude of intention towards the public in every line of conduct which he followed, he was an administrator whom the government of the day could not uphold against hostile interests." Yet to him, he goes on, "we of this nation unquestionably owe that our statesmen of those times were first awakened to the duty of caring for the Public Health, and that the first of our modern legislative endeavours were made to bring Health under the protection of the Law."

Chadwick retired on a pension of £1000 a year, his official career ended. He moved with his family to Richmond, living there till 1869 when he went to live at Park Cottage, East Sheen. He was only fifty-four and his energies were still unspent. Although he never returned to official life, he continued to take a very active part in all public affairs connected with the health of the nation. It was at his instigation that Lord Palmerston sent a sanitary commission to the Crimea which, by its work there, saved the second army, and enormously improved the health

and strength of the troops. It was his paper, read before the Social Science Congress at Liverpool in 1858, that drew attention to the urgent need for the experiences gained by the sanitary commission in the Crimea to be applied to India, where the death-rate among the troops in peace-time amounted to 125 per 1000 in the course of a year. This matter was taken up by influential people, Florence Nightingale among them, and resulted in the appointment of the Indian Army Sanitary Commission. The activities of the French in their researches in tropical medicine in Algeria did not escape his attention, and in 1855-56 he visited the Paris Exhibition to report on the sanitary systems there displayed. During this visit he had several interviews with Napoleon III. who had a lively interest in hygiene.

In 1867 Chadwick stood for Parliament as representative of the University of London, but although he had the powerful support of John Stuart Mill, he was not returned.

His last work for the nation was done in 1871, when the Secretary of State for India asked him to criticise a plan for the drainage of Cawnpore, and the alternative plan which he supplied was adopted by all the sanitary authorities in India.

On the formation of the Association of Sanitary Inspectors, Chadwick was elected President, and his annual address to this body came to be looked upon as one of the important events of the year. On the 2nd of March 1889, the Association gave a complimentary dinner to congratulate him on having entered his ninetieth year, and that day he received the Order of Knighthood. He lived to enjoy this late recognition of his invaluable services to the nation for another

year. But in June 1890, after rallying from an attack of bronchitis, in which no hopes for his recovery had been entertained, he insisted on driving to London to visit the Athenæum Club. Two days later he was taken ill and died peacefully on the 5th of July, having lived to see in a ripe old age what he had hoped for and worked for from the beginning of his career, the establishment on firm foundations of a real sanitary science.

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William Farr
1807-1883

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WILLIAM FARR, M.D., F.R.S., D.C.L., C.B.

1807-1883.

The story of William Farr's life has been described as uneventful, in that it chiefly consists in a "chronological list of the productions of his pen." Uneventful in one sense it may have been, but it cannot be called uninteresting, if we consider the range and extent and the ultimate significance, not only for his own country but for all nations, of his writings, the fruits of an industry never surpassed. Reading his works, it is difficult to think of their author save as a most active member of society to whom every human interest was of significance. Starting life with the most meagre education, except that which was self-imposed, he has left behind him a record of accomplishment little less than astounding, in the foundations which he laid of the practically new science of vital statistics in their relation to the public health. "My intellectual and inquisitive faculties," he said, in an autobiography begun but never finished, "were not developed in a public school, nor by the example and excitement of cultivated minds around me." And, although he became the greatest statist of his day, "a master of the methods by which arithmetic is made argumentative," as Sir John Simon says of him, what he learnt of mathematics he must have taught himself, for there is no record that anyone else ever taught him.

William Farr was born in the old-fashioned village

of Kenley in Shropshire on the 30th of November 1807. His grandfather was a small farmer in the parish, and his parents, who married young, moved to Dorrington, a village about 6½ miles from Shrewsbury, soon after his birth. Farr describes his mother as "extreme in all," "a woman of violent attachment and temper, retiring and solitary in her habits, of a strong mind, able and inclined to subsist on itself, religious from duty and for consistency, rather than from impulse or feeling," and, with it all, superstitious. Of his father he says: "He was good-natured, sensible, straightforward, a Christian in faith, feeling, and simplicity of heart." Such were his parents as Farr remembered them, but they were poor and, probably on account of their poverty, their son was adopted at the age of two years by the only well-to-do man in Dorrington, Mr Joseph Pryce. "No parson, no doctor, no great landed proprietor lived in Dorrington," wrote Farr in his autobiographical notes. "Joseph Pryce was the squire, as he was not only the richest, but the most influential man in the place." His house was constantly open to the poor; he provided them with coals and food in winter, and paid the apothecary's bill when they were sick; and on his adopted child lavished the most constant and tender care. Mr Pryce was over seventy when Farr became a member of his household, and of delicate health, and perhaps on this account the child was kept a great deal indoors. He went to the Dame School near by, and afterwards to Longnor School, about 1½ miles distant; but as the schoolmaster, according to his pupil's account, was "idle and empty-headed," he did not learn much. He was taught English grammar, geography and Latin by

the local dissenting minister, but from him also, he says, he learnt little. What he knew of classics and mathematics he taught himself, in spite of the limitations of Mr Pryce's library. *Brook's Gazetteer*, *The Whole Duty of Man*, *Sturm's Reflections* were the type of literature it contained, with Timothy Priestley's folio Bible, the pictures of which made a lasting impression on his childish imagination. "With what ghastly fear, and yet curiosity," he says, "did I look on the grim, grinning, bat-winged devils tormenting poor Job, and his wife muttering through them, 'Curse God, and die.'" He read everything he could find, but it was mostly theology, and for a time he had the idea of becoming a preacher.

It was by accident rather than design that he decided to take up medicine. To Dr Webster of Shrewsbury, a man of original and striking mind, he owed the stimulus that set the direction of his future. One evening in 1826, when the boy was nineteen years of age, the doctor paid a call on Mr Pryce. On the table in the sitting-room there lay a copy of the *Quarterly Review*, containing an article on "Contagion," by Dr Gooch. This led to a discussion on the subject of medicine, and as the doctor talked, "physic" seemed to Farr, to use his own words, a field that opened all at once before him. The next time he went to Shrewsbury he called on Dr Webster and arranged to study under him, being apprenticed at the same time to a surgeon, Mr Wyke, and becoming a "dresser" at the Royal Infirmary. To Dr Webster's enlightened direction, Farr declared, he owed all that he would "ever do that is useful or good." He acquired in Shrewsbury a tolerable acquaintance with

"the practical art of chirurgie," and learnt Italian from a native of Turin, a language which proved valuable to him at scientific congresses in after years.

In 1828 Farr had an acute attack of bronchitis, and old Mr Pryce, then ninety years of age, was "indefatigable" in his care for his recovery. But the same year Mr Pryce died, leaving a legacy of £500 for Farr's education. In the following year, therefore, he studied medicine in London and in Paris, and was especially attracted in the latter place to the subject of hygiene, more particularly in its connection with medical statistics. Dr Bain, whom he met in Paris, tells a story characteristic of Farr's preoccupation with any subject he had in mind. They were travelling together in Switzerland at the time after leaving France. "Mr Farr," he says, "while of a simple disposition, is endowed with a vastness of ideas and a philosophic mind. . . . I well remember the scene at our inn at Martigny, when after a walk to see the celebrated waterfall, about four miles away, I returned weary and hungry to dinner. To my surprise I found the entrance blocked up by at least one hundred of those miserable beings, the crétins, who inhabit the Valais in great numbers. On inquiry of the landlord, he told me that the gentleman inside had commissioned him to get together as many crétins as he could, so that he might examine them. After some difficulty I wedged my way into the room, where Mr Farr was standing with a table and numerous large sheets of paper before him, on which he was making the shapes of the different heads of which he had previously taken the contours, vertically and horizontally, by means of a leaden tape. That day we dined late."

On his return to England, Farr attended lectures at University College, and for six months was temporary house-surgeon at Shrewsbury Infirmary in the absence of the permanent holder of that post. Had he possessed any medical degrees, he would probably have been appointed to the vacancy when the six months expired, and the whole course of his career might have been altered. Instead, he returned to London to continue his studies at University College, and in March 1832 passed the examination for the L.S.A. at Apothecaries' Hall. In later years many honorary degrees were to be conferred upon him, but this was the only medical qualification he obtained by examination. After his marriage to Miss Langford of Pool Quay, near Shrewsbury, in 1833, he settled down in practice in Grafton Street, Fitzroy Square. He was still preoccupied with the subject of vital statistics and hygiene, contributed many articles to the medical journals on these questions and, without success, tried to get authority to give a course of Public Health lectures, to which he gave the title of "Hygiology," but it was not considered a subject of sufficient public interest. Chadwick's writings which were so forcibly to alter the public outlook in this direction, had only just begun, and four years had yet to pass before Sir John Simon was appointed first Medical Officer of Health for the City, from whence his stirring annual reports, with their vivid descriptions of the consequences of neglect of sanitary affairs, were to arouse and alarm apathetic citizens. The Hygiology lectures that were to have been, were then published in the *Lancet* for 1835-36 by its far-seeing editor, Dr Wakley.

In 1837 Farr became a joint-editor of the *British Annals of Medicine*, and his essay on "A Method of determining the Danger and Duration of Diseases at every Period of their Progress" came out in this magazine. The same year he lost his old friend Dr Webster, and inherited from him a legacy of £500, together with the doctor's library. Sorrow, too, came to him nearer home when his wife died of consumption. He married again, in 1841, Miss Whittall of Deal, by whom he had a large family of eight children, five of whom survived him. After his second marriage he moved from Fitzroy Square to Stoke Newington. 1838 saw the publication in the *Lancet* of his papers on "Benevolent Funds and Life Assurance in Health and Disease," and "The Law of Recovery and Mortality in Cholera Spasmodica." "A History of the Medical Profession and its Influence on the Public Health" appeared in the *British Medical Almanac*, but the work which established his reputation as one of the foremost thinkers of the day was published in McCulloch's *Account of the British Empire* under the title "Vital Statistics," an essay which laid the foundations of the new science to which he devoted his life. His was the first successful attempt to give mathematical expression to the rise and fall of epidemic diseases, says Dr Charles Singer in *A Short History of Medicine*. Farr was the first to observe that the rise in the numbers of cases of a disease during the course of an epidemic corresponded to the decline of cases during its fall in equal periods of time. He noted the tendency to mathematical symmetry in the rise and fall of diseases, and when cattle-plague occurred at a later date, he was able publicly to predict its course and the date at which

it would reach its maximum with a degree of accuracy which surprised his hearers.

The article on "Vital Statistics" and his growing reputation as a statist, combined with Chadwick's early recognition of his genius, led to his appointment as Compiler of Abstracts in the new Government Department of the General Register Office at a salary of £350 per annum. This large central office with its thousands of subsidiary local offices which poured in upon it the stores of information required by the Births and Deaths Registration Act of 1836 was as yet undeveloped. Major Graham who became Registrar-General in 1842 was an able organiser and a rigid disciplinarian, and maintained a high standard of efficiency in his department during his long tenure of office; but to Farr was due the development of a national system of vital statistics, which not only unlocked the door to the rapid advance of sanitary science in England, but also became the model for all civilised countries. His was the task of making all the facts and information in the life and death registers intelligible to the ordinary mind and of use in guiding future legislation. It was fortunate that he was a man of such wide outlook and sympathies to whom the art of generalisation came as a second nature. It was fortunate, too, that he had so much literary ability and imaginative power. The chaos that existed in the registration returns when Farr took over the work, was in no small measure due to the confusion in naming and classifying diseases. In the words of his report, he found that "each disease has, in many instances, been denoted by three or four terms, and each term has been applied to as many different diseases, . . . complications have been

registered instead of primary diseases"; and he pointed out that "the nomenclature is of as much importance in this department of inquiry as weights and measures in the physical sciences." Until this state of things was corrected, it was obviously impossible to get returns of any value, and Farr did not rest until he had established an ordered system of nomenclature.

The first Annual Report of the Registrar-General was published in 1841, and it had appended to it a long letter addressed to that officer on the causes of death in England, which was soon seen to be the work of no mean writer. Each Annual Report as the years followed one another had such a letter from the Compiler of Abstracts appended to it, and they have become classics in medical literature, all of them, it has been said, "from first to last marked by the same lucid marshalling of facts, the same masterly command of all the resources of method and numerical investigations, the same unaffected and vigorous English, breaking out every now and again, when stimulated by a clear view of some wide generalisations, into passages of great eloquence and pure philosophy." *The Statistical Classics of William Farr, Registrar-General's Reports* and the *Supplementary Reports*, dealing with English mortality statistics from 1851-60 and 1861-70, tell the story of Farr's exhaustive labours at the General Register Office, and treat of every subject connected with vital statistics. By this work he established the connection between mortality statistics and the health of the people, a lesson which the nineteenth century had been slow to learn, and the direct effect upon practical medicine was one from which the public derived incalculable benefit, for, as has been ably said,

"The constant endeavour after exactness of diagnosis and precision of nomenclature is itself a wholesome discipline, which reacts inevitably upon treatment."

Farr was appointed Assistant Commissioner for the Censuses of 1851 and 1861, and Commissioner in 1871. The census reports for these years were entirely written by him and in them some of his most valuable work is to be found. The titles and the subjects of his works have to the layman's ear a dull sound, but to Farr they were by no means dull. He lit up the driest subject with the bright rays of his intellectual interest in it, and presented his dry facts in their true relation to the affairs of every-day till the resulting picture teemed with life. Of the *Tables of Lifetimes* with an Introduction by William Farr published by the Register Office, Mr Noel Humphreys, the editor of Farr's work *Vital Statistics* and a fellow-worker, says: "Only those officially connected with Dr Farr in the General Register office, and who worked on this laborious volume under his superintendence, had the means of fully realising the unremitting attention he gave to every detail of the work, or the intense and unvarying interest he maintained in every successive process. It is not easy to forget the expression of his countenance, beaming with pleasure and triumph, almost childlike in its unaffected simplicity, when (during the progress of the Life Table, No. 3) he reached the office one morning with a small page or two of MS., containing one of these formulæ which had taken him all night to work out." And the report, *The Mortality of Cholera in England*, 1848-49, containing the history of the epidemic in East London and an account of his investigations into its cause

and connection with the polluted water-supply, is a classic in medical statistics, famous, as Sir John Simon says, for the literary power with which the story of this disease is told.

Although his work in the General Register Office entailed such continuous labour, he still found time to write for outside journals. The list of his contributions to the *Journal of the Statistical Society* alone is a formidable one, containing such essays as, "The Mortality of Lunatics, 1841-1846"; "Influence of Scarcities and of the Prices of Wheat on the Mortality of the People of England, 1846"; "Civil Service of England, 1849"; "Income Tax and Property, 1853"; "The Mortality of Children in the Principal States of Europe, 1866," and many others; his last contribution to the Society of which he was at one time President, being "Valuation of Railways, Telegraphs, Water Companies, Canals, in 1873."

In 1855 Farr was elected a Fellow of the Royal Society and received the honorary degree of D.C.L. of Oxford University, and in this year his salary was raised to £800, with a supplement of £200 "in consideration of his eminent services in connection with mortality and census statistics." It was again raised in 1874 to £1100 with a special allowance of £300; and there is no doubt that he would have received a greater reward but for the fact that the salary of his chief, the Registrar-General, was only £1200. In 1859 "A Healthy District Life Table" was published in the *Proceedings of the Royal Society*. Farr had now moved from Stoke Newington to St John's Wood, where he constantly entertained his many friends, until in 1860 he left London and settled in Bickley, Kent.

Between the years of 1853 and 1876 he attended, for the most part as the official delegate of the English Government, many statistical congresses abroad in Brussels, Paris, Vienna, Berlin, Florence and the Hague. He spoke French, German and Italian fluently, and was often able to address the Congress in the language of the country where it met. His description in French of the outbreak of cholera in East London, its sudden onset, its appalling ravages and its equally sudden cessation when the polluted water-supply was stopped, was listened to in breathless silence. In Europe Farr's reputation was such that he was commonly regarded as the Registrar-General of England, as he was by a large majority of people at home, and his reputation as the founder of the English national system of vital statistics was world-wide.

In 1876 he lost his second wife, a shock from which, combined with the effects of an illness he contracted while attending the Statistical Congress at Buda-Pesth, he never completely recovered. Three years later, he left Bickley and settled in Maida Vale, in the anticipation that he would succeed Major Graham who was about to retire from the Office of Registrar-General. Major Graham, as the administrative chief of 3000 registration officers, had contributed largely to the success of civil registration in England, but in his farewell address to the department he referred in warm terms to the all-important part Farr had played in the development of the work. "He is acknowledged," he said, "throughout Europe, the United States, East Indies, and the Colonies, as one of the first statists of the day. To his scientific researches I attribute any reputation

that may have accrued to the General Register Office of England and Wales from the time I accepted office in the Department."

When the Government appointed Sir Brydges Henniker to succeed Major Graham as Registrar-General, passing over Farr, who had hoped to hold the office even for a short while, the indignation of the public and of the medical profession was great. Farr immediately sent in his resignation, writing at the same time to the *Times* to explain his action to the public. "Although warned by the state of my health," he said, "that I was in need of a rest rather than of increased duties and responsibilities, I was induced by the hope of enlarged opportunities of rendering assistance in the approaching census, and in the promotion of public health and sanitary statistics, to become a candidate for the post of Registrar-General. Failing to obtain that promotion, I no longer hesitated to seek that retirement which my friends had previously urged upon me."

On his retirement on the 1st of February 1880, he was awarded the C.B., and received a pension of £800 per annum to which a public subscription of over £1000 was added. On the 12th of August, the Gold Medal of the British Medical Association, "the highest honour that the Association has power to give," was conferred upon him "as an expression of their high appreciation of his long, unwearied and successful labours on behalf of statistical and sanitary science; as a recognition of the light he has thrown upon many physiological and pathological problems, and on account of the extraordinary services his work has rendered to the advancement of the health of the nation."

His health, already showing signs of failure, did not long survive the sudden break from a lifelong habit of unremitting labour to complete rest, and soon after his retirement from office softening of the brain set in. He died on the 14th of April 1883 in his seventy-sixth year.

Farr was greatly loved by his many friends and he left behind him the bright memory of his genial face and happy laugh. He was not a great talker, but a good listener. It was said of him that "had he possessed more self-assertion, not to say selfishness, and less trust in others, his worldly success would have undoubtedly been greater, but his character would have been the less lovable."

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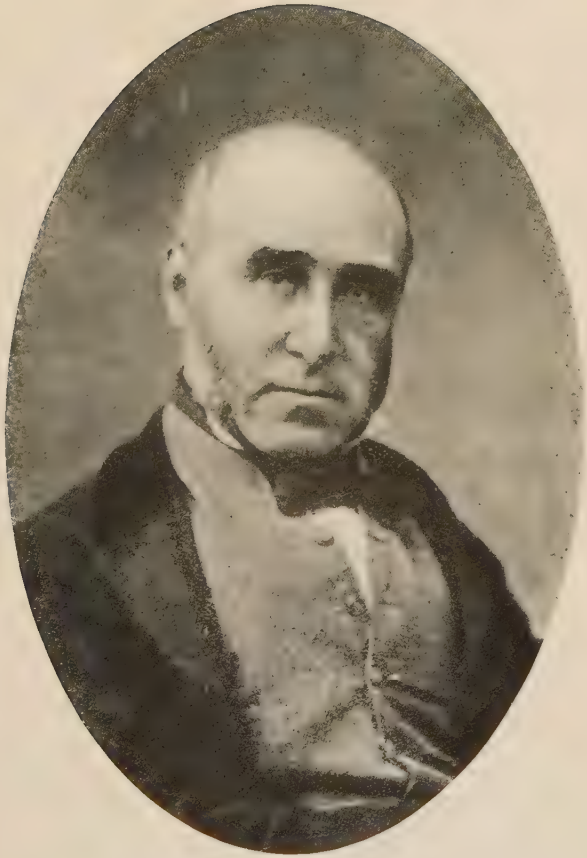
SIR JOHN SIMON, K.C.B., F.R.S., F.R.C.S.

1816-1904.

The year 1800 had seen the birth of the great lay reformer, the founder of sanitary science in England, Edwin Chadwick, and he was still but a boy when another genius, one destined to carry the work far in the more fruitful field of preventive medicine, saw the light of day.

John Simon, one of the fourteen children of Louis Michael Simon of Blackheath by his second marriage to Mademoiselle Matilda Nonnet, was born on the 10th of October 1816. His paternal grandfather, who had settled in London as a merchant and there married an English wife, was a native of Montargis in France, and his father, an only son, became a leading member of the Stock Exchange, serving on the General Purposes Committee of that body. By descent, therefore, Simon was rather more French than English. Both his parents lived to great old age, his father being ninety-eight and his mother ninety-five, the latter surpassing by fifteen years what Simon calculated as the natural term of life in this country. "Death by old age is, physiologically speaking, the only normal death of man," he said. "Death by natural decay would in this country under present circumstances, usually happen about eighty years of age. Now little more than a tenth part of the deaths of England happen at seventy-five years



Sir JOHN SIMON
1816-1904

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and upwards, and thus, physiologically speaking, one may say that at least nine-tenths of the entire mortality occur more or less prematurely."

Simon was sent to a private school at Pentonville, then to the school of Dr Burney, a nephew of the author of *Evelina*, at Greenwich, where he spent seven years. From there he went to Hobensolms in Germany and stayed for one year under the care of a German pastor. His father intended him for surgery and in 1833, at the age of seventeen, he was apprenticed to Mr J. H. Green, Professor of Surgery at King's College and surgeon to St Thomas's Hospital, a man distinguished alike in his profession and in scholarship, and a friend of the poet Coleridge. Simon became demonstrator in anatomy, and in 1838 was elected a member of the Royal College of Surgeons. Two years later he was appointed assistant surgeon at King's College Hospital, and in 1845 his remarkable paper on "The Comparative Anatomy of the Thyroid Gland," considered an exceptional achievement for so young a man, won for him the Astley Cooper Medal for Physiology and he was elected a Fellow of the Royal Society at the early age of twenty-nine. In 1847 he received the appointment of lecturer in surgery at St Thomas's Hospital, and in the same year published a paper "On the Aims and Philosophic Method of Pathological Research," a work which showed, what was rare in the forties, an understanding of the vast significance for society of the science of preventive medicine. At this time the duty of the State for the care of the health of its citizens was not generally acknowledged. There were no medical officers of health, and Simon was to become the creator of that office in London and

before his day was done, to witness, what his own words may best express, "a spirit so changed from that of the old times as virtually to be the adoption of new standards of weight and measure in polities."

In 1848 Simon married Jane, the daughter of Matthew Delaval O'Meara, and shortly afterwards he received his first public appointment, when the Corporation of London, following Liverpool's example, decided to appoint a Medical Officer of Health for the City. Their choice fell upon a man whose rare combination of faculties for the position he was appointed to fill could scarcely have been surpassed. When Simon accepted the post the conception of a medical officer in an administrative position was quite new, and although the activities of the Poor Law Board since 1832, under Chadwick's powerful direction, had drawn public attention to the scandalous conditions under which the poor of the country lived, it was not generally recognised even by the commissioners themselves, that these could properly be dealt with by the medical profession. The General Board of Health, established in 1848 on the break up of the Poor Law Board, did not, in spite of its name, include among its commissioners (Lord Carlisle, Lord Shaftesbury, and Chadwick) a medical officer, until two years after its formation, the effects of the violent epidemic of cholera of 1848-49 and the needs of the Interments Act, forced the authorities to elect Dr Southwood Smith as a member. This connection of a doctor with the Interments Act, a measure for the prevention of overcrowding in the graves of the city churchyards, so amused the medical profession that one member of it published the criticism: "Who

would have thought that in the last decade of advancing civilisation, and in a nation boasting of its intellectual and material resources, of its administrative energy and efficiency, the whimsical experiment should have been actually tried of appointing three non-medical authorities — two lords and a barrister—to preserve the health of the living, and then, after a year or so of doubtful success, calling in a physician to bury the dead?" On the other hand, Lord Palmerston's reply to an appeal from the Edinburgh Presbytery a few years later to appoint a great religious fast in the hopes that this might stay the third cholera invasion, was significant of the changing outlook in the sphere of public health: "It did not appear to Lord Palmerston," he wrote in a published letter, "that a national fast would be suitable to the circumstances of the present moment. The Maker of the Universe established certain laws of nature for the planet on which we live; and the weal or woe of mankind depends upon the observance or neglect of those laws. . . . Lord Palmerston would therefore suggest that the best course which the people of this country can pursue to deserve that the further progress of the cholera should be stayed will be to employ the interval which will elapse between the present time and the beginning of next spring in planning and executing measures by which those portions of their towns and cities which are inhabited by the poorer classes, and . . . must most need purification and improvement, may be freed from those causes and sources of contagion which, if allowed to remain, will infallibly breed pestilence, and be fruitful in death, in spite of all the prayers and fastings of a united but inactive nation."

It was not long before the Corporation of the City of London were made fully alive to the consequences of the experiment they had made, for Simon swiftly brought to bear on his new office his great scientific genius and administrative skill, and the need for medical guidance in matters relating to the public health became abundantly plain. The conditions that he had to contend with are not easy to picture in the twentieth century. Overcrowding in the poorer districts was terrible, "the shocking custom of inhabiting cellars," spoken of by Dr Roberton in his book on *Medical Police* in 1809, still prevailed in 1850, for the window tax put a premium on light and ventilation; slaughter-houses, of which there were 130 within the city boundaries, were mostly in underground vaults of the most unwholesome description; although public conduits existed, they were often padlocked against too lavish a use, and water for the poor was delivered sometimes in a putrid state from the insanitary cisterns where it was stored; the drainage system was disgracefully neglected, and infectious diseases ran their course unchecked. Among the poor it was common for the dead to be kept a week before burial in the one room of the living. The public conscience was awakening to these things, but it was slow to act. Free circulation of newspapers did not exist because the stamp duty and the tax on printing confined the journals to the few, and as often as not the speeches of Members of Parliament went unreported, because of the tyranny the press was able to exercise in the choice of what it would report. In order that ignorance might no longer be their excuse for inaction, Simon opened upon the public the floodgates of

knowledge. His Annual Reports for the years 1848-1855, when he held the office of Medical Officer of Health for the City, have become a classic in the history of English sanitation. In them he exposed to the light of day all the degradation under which the masses of the people were obliged to live. He showed the risks that arose from the bad drainage in the spread of cholera and other diseases, and the means taken to overcome these evils, especially the improvements in the sewerage undertaken by the Corporation, in the water-supply and in a system of periodical inspections. He began his official career by throwing himself on the compassion of the Registrar-General, in his own phrase, for without his special help he might have had to wait indefinitely to hear of any death which had occurred within the City boundary. As it was, punctually every Monday morning the nine City Registrars by a voluntary arrangement provided the Registrar-General with returns of deaths registered during the previous week in their districts together with the causes, and punctually every Monday afternoon these papers were placed at Simon's disposal and, guided by the information they contained, he set about his schemes of local inquiry and inspections. Gradually by this means a regular system of weekly inspection in all the poorer parts of the city was built up. His reports bear witness in their masterly English to the colossal labours undertaken by Simon in the seven years he spent in the City. Plain language was needed to attract public attention to the degrading state of affairs which was tolerated by a great nation, and Simon did not hesitate to use it. Congratulating the Corporation in 1855 on the abolition of cesspools

(one of the greatest of the evils), he said: "When cesspools were still almost universal in the metropolis, and while in the mansions of the West End they were regarded as equally sacred with the wine-cellars, they had been abolished, for rich and poor, throughout all the square mile of the City." The reports, much in demand at the time, were eventually republished, prefaced by an essay entitled "A Ministry of Public Health," in which Simon's conception of the ideal Health Department was ably set forth.

As a result of the awakening of popular interest in health matters, a great deal of voluntary work among the poor was undertaken, and in 1850 the Epidemiological Society of London was formed for the study of the causes of disease and premature death, with the object of advising administrative authorities on the best means of prevention. Most of the leading scientific men of the day were connected with this Society and Simon was one of the founders. In 1853 he served on a Commission of Inquiry into the causes of the cholera outbreak at Gateshead and Newcastle, where public alarm was assuming the proportions of a panic. It was during this epidemic that a Council of the Medical Profession consisting of thirteen distinguished members, among them Simon, was called into being to give advice in the preventive measures to be adopted.

The first Board of Health, which was virtually Chadwick, came to an untimely end in 1854, when the Commons, irritated by what was considered Chadwick's too masterful policy, refused to renew its life. In after years, writing in *English Sanitary Institutions*, Simon referred to this slur on Chadwick's work in the following terms: "Mr Chadwick beyond

any man of his time, knew what large fresh additions of human misery were accruing day by day under the then almost universal prevalence of sanitary neglect, and the indignation which he was entitled to feel at the spectacle of so much needless human suffering is a not ignoble excuse for such signs of over-eagerness as he may have shown."

In 1855, a new Board of Health, subject to annual renewal, was appointed with power to elect a medical officer, and Simon was offered, and accepted, the position. At this time "none but the vaguest notions had been formed as to the work which the officer ought to do," says Simon. Government had no statutory functions of a medical kind except under the Diseases Prevention Act, which was only called in force when epidemics arose. The general view taken was that the functions of a medical officer should be confined to fighting the dangers of the diseases when they occurred. These were, needless to say, not Simon's ideas of his office. "To stand and wait in the ante-chambers of legislation" was hardly his notion of service to the State; but owing to the antagonism which had been created by the activities of the first Board of Health, and the uncertainty attaching to the term of his appointment, he found it impossible to inaugurate a policy of sanitary reform such as he would have desired. "The legislature recognises no medical authority," he said, in his essay on "A Ministry of Public Health." "Occasionally this fact stands out in painful conspicuousness and brings most injurious results." In his first four years then, when his office was more or less on trial year by year, he made it his business to teach the nation how necessary a medical department had become to the needs of the

country. In 1856 was published his report reviewing all the inquiries made for the Board of Health during the cholera outbreaks of 1848-49 and 1853-54. In it he compared the different degrees of mortality which had accompanied the different water-supplies in the southern districts of London. For this purpose the populations which had received these different supplies had had to be identified, and when this laborious undertaking was accomplished, it was made plain that Lambeth, with the purest water-supply, had suffered least from cholera. Reviewing the mortality returns, he said: "No reasonable person could doubt the extremely important significance of that uncomplicated final arithmetic." In 1857, he published a comprehensive report on the subject of vaccination entitled *Papers relating to the History and Practice of Vaccination*, reviewing all the medical experience up to date with an account of the disastrous ravages of smallpox. It was only in 1853 that vaccination had been made compulsory in England, and the controversy for and against it was to rage around this subject for many a day to come. In 1856 it was proposed to appoint a select committee to receive the evidence against the practice, and Simon's report was prepared in anticipation of having to provide counter-evidence. The committee, however, was not then appointed, and fourteen years later, in 1871, after the Vaccination Act of 1867 had been passed, for which Simon was in a great measure responsible, his report was used when the opponents of vaccination were invited to state their case before the Commons.

In 1858 his famous *Report on the Sanitary State of the People of England*, which has since become another classic of sanitary science, was published.

It was republished in 1887 under the title *Public Health Reports*, edited by Edward Seton, M.D. This work, based on the laborious collection of facts which Simon and his brilliant staff had got together from all parts of the country, clearly showed for the first time the extent to which diseases varied in different parts of the country, and the need for a reliable record of their occurrence. The case it presented for the establishment of a medical department of Government was unanswerable, and in 1859, after the passing of the Public Health Act of 1858, when the functions of the Board of Health were absorbed by the Privy Council, Simon was permanently appointed medical officer to that Council, an office which he held until 1876, using to the full the opportunities it offered for his genius and skill in organising an efficient medical service. In 1858, too, he published his *Paper on the Constitution of the Medical Profession*, dealing with the much needed reform of the regulation of medical education. It was followed by the passing of the Medical Act, by which the General Medical Council was established, with a system of registration "to enable persons requiring medical aid to distinguish qualified from unqualified practitioners." Before this Act "the legal titles of medical practitioners were as various as the names of snuffs and sauces," to quote Simon again. There were twenty-one different authorities, mostly of mediæval origin, at liberty to issue credentials for medical qualification, and the State did not concern itself with the terms on which these were granted.

The Privy Council Reports from 1859 to 1872 give an account of Simon's labours as medical officer, and of those of the eminent scientific workers whose

investigations he directed. Such well-known names as Burdon Sanderson, Bristowe and Thorne Thorne testify to the high standard of the inquiries made. The measures undertaken to procure an efficient service of vaccination had the advantage of bringing his inspectors into contact with every part of the country, and he procured by this means, not only an account of vaccinations, but reports on the incidence of many other diseases as well, including diphtheria, diseases of the cotton famine, cerebro-spinal meningitis and cholera. In 1862 he set on foot inquiries into the evil effects of dangerous industries on health, by lead, mercury, phosphorus and arsenic poisoning. In 1863 a survey of the hospitals of the United Kingdom was undertaken, and in 1864 a most valuable report on the housing of the poor in towns and country was issued, the results of which showed conclusively the advantages and value of good sanitation in saving life in the districts where it had been practised.

All these investigations were chiefly connected with the administrative work of his office, but from 1866 onwards researches of a purely scientific nature were instituted without reference to immediate practical results, in the certain hope that "they would lead to more precise and intimate knowledge of the causes and processes of important diseases, and would thus augment more and more the vital resources of preventive medicine." Although Simon knew of the germ theory, he did not believe it was far enough advanced to be of any practical value, and he thought its evolution would be a slow process. He was more interested in the classification of contagious diseases by the uniformity of their symptoms than by Pasteur and Koch's method of isolating the micro-organisms of infection.

In his reports Simon has described the chaos that existed in the administration of the local Government, and in 1868 a Royal Sanitary Commission was appointed to inquire into the administration of sanitary laws and the formation of local sanitary areas. This Commission reported in 1871, recommending the amalgamation of the old Poor Law Board, the Local Government Act Office, which was then part of the Home Office, and the Medical Department of the Privy Council; the new department thus constituted, the Local Government Board, to be under the direction of one Minister with possibly two permanent secretaries. There was no reference in the report to the work of the Medical Department of the Privy Council, or to the questions of industrial diseases, unhealthy conditions of employment, or the administration of the Medical and Pharmacy Acts. To Simon the amalgamation of the Health Department with the Poor Law Board seemed a retrograde step. He regarded it as "virtually a policy of retreat." The Commons, however, endorsed the recommendations of the Commission, and the Local Government Act of 1871 established the new department. In the hope that he would be given a free hand in inaugurating a satisfactory medical policy, Simon accepted the post of Chief Medical Officer to the new Board. His hope was not realised, for he found that the Medical Department was placed in a subordinate position under the poor law staff, and instead of the medical policy being under scientific direction, he was obliged to witness the blunders of the civil officers, acting without his advice in the formation of sanitary areas, the cutting down of all medical investigations, and the supplanting of his able staff by poor law officers. The

President, Sir James Stansfield, and Sir John Lambert, the Secretary, refused him the initiative and administrative independence to which his great work in the Medical Department of the Privy Council had entitled him, and the bitterness of his position in having to witness the loss of the splendid opportunities for the development of an efficient public health service, became intolerable. "He endured," says Professor Burdon Sanderson, "perhaps with too little patience, the constantly recurring pinpricks of official interference." In 1876, when the policy of the new Board had become fixed, Simon asked leave to retire. His office was abolished and he received a pension of £1333. His resignation at the age of sixty in the full vigour of his strength deprived the country of the services of one of the most brilliant scientific and administrative officers the nineteenth century had seen, and the substitution of the Local Government Board methods for Simon's statesmanlike conception of a Ministry of Health delayed the progress of sanitary science. Long after his retirement, his successors were still struggling against the same inter-departmental difficulties against which he had so ably, though so vainly, protested.

English Sanitary Institutions, published in 1890, contains the history of sanitary science in England and a record of Simon's work, told in the classical English for which his writing is famed. This volume alone, by reason of its vivid language and literary merit and its wide human outlook, would have procured for Simon a high place in the annals of famous men.

On his resignation in 1876, Simon was decorated with the C.B., and in 1887, on the occasion of the Queen's Jubilee, he received the order of knighthood.

He was Crown Member of the General Medical Council from 1876 till 1895, Vice-President of the Royal Society in 1879-80, and received numerous honorary degrees from universities at home and abroad. The Buchanan Medal of the Royal Society was awarded him in 1897 for "eminence in sanitary science," and he also received the Harben Medal of the Royal Institute of Public Health.

On his retirement, he lived in his old-fashioned house in Kensington Square, where he entertained a distinguished band of friends up to the last days of his long life. Thackeray, who lived near by, Tennyson, Rossetti, Burne-Jones, and Jowett were often to be found at the gatherings in his house, among many of the other famous men of the century, for Simon was a man of wide interests. "Cultivated to an extraordinary degree," says Dr J. F. Payne, "a linguist, a student of Oriental literature, the friend of artists, poets and philosophers, he was able to think grandly, to project his mind into the future, to discern the real meaning of social evils as well as their probable developments, and so to devise schemes of prevention and amelioration that could never have occurred to more plodding, if equally industrious, spirits." And again, it was said of him: "Such was the versatility of Sir John Simon, at so many points did he touch the intellectual life of his time, that it would be misleading if we considered him merely from the sides of scientific and official achievement. Simon was, indeed, much more than a great officer of health and writer on preventive medicine, hygiene and surgery. He belonged to the highest type of the man of culture and progress in the middle of the last century. Friend of Buckle, Claude Bernard, Charles

Kingsley and Ernest Renan, he was a social force in quarters where science seldom shows her face—among distinguished circles, both literary and artistic, political and social, where the man of science is only too apt to be regarded merely as the enemy of æsthetics or the chiller of enthusiasms."

Simon outlived most of his contemporaries. Ultimately his eyesight began to fail and "plunged him in a great darkness," as he so aptly described the condition. After a short illness, he died on the 23rd of July 1904, at the great age of eighty-eight.

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MAX VON PETTENKOFER
1818-1901

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MAX VON PETTENKOFER, M.D.

1818-1901

FOLLOWING in the footsteps of Johann Peter Frank, whose teaching and writings had laid the foundations of the science of hygiene in Europe, there came the great pioneer of practical hygiene in Germany, Max von Pettenkofer. He was a man of strong character and personal charm, who would, no doubt, have made his mark in any profession; but by what a narrow margin he escaped being brought up as a peasant to work on the land, when his activities would have been turned in quite other directions than medicine, his early history reveals.

Born in the small village of Lichtenheim, near Neuburg, on the 8th of December 1818, just a few years before the death of Frank, Max von Pettenkofer was one of the eight children of a small farmer. His paternal grandfather had been customs official or toll-keeper in the village, and lived in the house allotted to him by the Government with its bit of ground, which he received on the union of Neuburg with Bavaria. He earned his living by the cultivation of the Danube fens, and it was a hard-working life, allowing little leisure for any kind of study. Of his four sons, the youngest, Max's father, was brought up to work the land, while his elder brothers received a more liberal education. One of them, Franz Pettenkofer, became Army Apothecary in the Russian

campaign and, in addition to making large profits while the war lasted, received, when it was over, the appointment of Court Apothecary in Munich in 1828, and lived in the official residence attached to his position. He was rich and childless, whereas his hard-working brother in Lichtenheim had little means with which to educate his family of eight except as peasants, and so the young Max, fortunately for the future of hygiene, was sent to Munich to be brought up by his uncle. He received his education at the Munich Gymnasium, obtaining a leaving certificate with distinction, and afterwards at the University. Guided by his uncle, he took up the study of the Natural Sciences, especially mineralogy and chemistry, with a view to his being apprenticed to pharmacy. And accordingly, in 1839, he became a pupil in the Royal Court Pharmacy, and was promoted within a year to the position of assistant at the remuneration of a florin a day.

So promising a beginning to his youthful career was, however, checked by the impetuousness of his sensitive nature. A quarrel with his uncle, in the course of which he received a box on the ears in the presence of other assistants in the office, caused him to throw up his post and embark upon a theatrical life at Regensburg. The stage, however, had few attractions for him; his performances met with a cold reception in the press, and after a few months, in spite of his reluctance to return to the Court Apothecary's house, he was persuaded by his cousin Helen Pettenkofer, whom he afterwards married, to come back to Munich, and in 1841 he took up his studies again at the University. He would gladly have devoted himself to chemistry and mineralogy,

but Franz Pettenkofer was anxious he should study medicine which offered a surer means of livelihood, since, by his theatrical adventures, he had, in his uncle's opinion, forfeited the chance of a post in the Court Pharmacy. Neither of them could then foresee that the young man was eventually to hold the chief appointment in this Department for over forty years. Applying himself to medicine, Max passed the examination for the apothecary's licence after the short period of two years in March 1843, and a few months later obtained his medical degree with a remarkable thesis, "Dissertation über die Micania Guaco," containing an account of a bitter substance he had extracted from the leaves of this plant, which produced a rapid pulse and profuse perspiration.

Pettenkofer now wished to study under Liebig, but was unable to get a place in the laboratory of this famous chemist at Giessen until the summer of 1844. In the meantime he went to Wurzburg. His remarkable aptitude for chemistry and physiology led him to the study of physiological chemistry, and his early work was devoted to the processes of metabolism, those chemical changes within the body associated with living matter. At Wurzburg, by the discovery of an acid in urine (hippuric acid) he established for the first time the influence of nourishment on the composition of the urine. He followed this up with an attempt to extract fat from sugar by means of sulphuric acid and gall; and although he was not successful in this, he made, in the course of carrying out the experiment, his celebrated discovery of the reaction of the violet dye upon gall, the bile-acid test, afterwards called by his name, and described by Garrison in his *History of Medicine* as one of

the earlier chemical investigations of importance to medicine. These experiments were described in Liebig's *Annual*. At Würzburg also he began the researches, afterwards continued at Giessen, which led to the discovery of the substance called *creatine*, an organic base found in the juice of meat, hitherto unknown to chemists. This discovery made so deep an impression on Liebig, that he immediately undertook his own researches into meat, the results of which were published in 1847, and led to the production of Liebig's *Extract of Meat*. It is not generally known that Pettenkofer was the originator of this familiar food.

By his brilliant work at Giessen, Pettenkofer had won the esteem and friendship of his teachers, Liebig, Fuchs and Bischoff, and would gladly have stayed at work in the laboratory of the great chemist; but lack of means obliged him to leave what he described as this "inspiring scientific life" and to return to Munich. At Munich he approached the authorities in the hopes of obtaining an academic appointment in the University, but failing to do so, was driven to accept a post in the Mint at 1½ florins a day. This turned him again from medicine. It was, however, a livelihood enabling him to marry, and in the end he had so adapted himself to the work in the Mint, discovering a method of treating gold chemically which proved of value in extracting the pure metal, that, when the prospect of an academic career at last presented itself, he preferred to remain in the Mint Office at a salary of 2000 florins a year and a free house. But Liebig and Fuchs, being reluctant that Science should lose so promising an investigator, intervened and, as a result of their representations

on his behalf, he was offered and accepted in 1847 the appointment of Extraordinary Professor of Pathological Chemistry in the University of Munich, a position which he held till his promotion to Ordinary Professor in 1853.

From this time onwards his energies were devoted to the cause of hygiene, and his services to science began to be publicly recognised. He was elected an Extraordinary Member of the Bavarian Academy of Sciences in 1846, a Member of the Council of Medicine in 1849, and in 1850 received the appointment of Chief of the Court Pharmacy and personal Apothecary to the Court, an office he retained till 1896.

Munich was at that time as insanitary as most large towns on the Continent, and the conditions under which its poorer population lived afforded only too good a breeding ground for the diseases which from time to time swept over Europe. Cholera had been introduced from Asia in 1831, and the year 1854 witnessed the third of the violent epidemics of this terrifying scourge. In addition, typhoid fever and typhus were continually breaking out, so that the city of Munich had little respite from either the one or the other pestilence. Pettenkofer with his boundless energy and resource was determined to trace, if it were humanly possible, these diseases to their source. At the time, Dr Snow's investigations into the sewerage systems of London and into the sources of water-supply, were meeting with considerable success in the prevention of cholera in the districts where new drainage had been introduced; and the severe epidemic of 1854 led Pettenkofer to undertake an elaborate inquiry into the supply of

drinking water in Munich in the parts of the town where cholera was most concentrated, for he believed that the water-supply was the means by which cholera and typhoid were conveyed. In the city there were several sources of supply, and by ascertaining from which source each house was served, either by means of the water-rate it paid (royal or municipal), or by personally inspecting the houses, Pettenkofer hoped to trace a connection between the water and the incidence of the disease. He failed, however, after the most careful inquiries, to prove any connection between the water distribution and the cholera cases. The same applied to his investigations into typhoid fever. He therefore concluded that in Munich, at all events, there was no ground for the belief that these diseases were due to defective drinking water.

The causes of cholera and typhoid, therefore, had to be sought elsewhere, and Pettenkofer next directed his attention to the soil and subsoil water around Munich. Extensive investigations were made; Pettenkofer-wells, by means of which the level of the subsoil water could be measured, were sunk, and records kept of the moisture in the soil at various periods including the seasons when epidemics were frequent. Pettenkofer's theory that the causative agent of cholera was nurtured in the soil when the soil contained the requisite amount of moisture for its growth, obtained a wide currency, and investigations along the same lines that he worked on in Munich were carried out by the Government of India. These researches were begun in 1856 and continued for the next twenty years. In his work entitled *Boden und Grundwasser in ihren Bezuchungen zu Cholera und Typhus*, he expounds his theory of

the development and spread of cholera and typhus according as the subsoil water rose or sank. According to this theory the necessary conditions for the spread of these diseases were, "the presence of the specific germ in the soil; a susceptible population predisposed to infection; and a soil saturated with organic matter, together with conditions of porosity affected by temperature and moisture or by the rise and fall of the ground-water." And although Pettenkofer was mistaken in the causes to which he attributed these diseases, nevertheless, the improvements made on his advice in the drainage system and the water-supply of Munich, practically rid the city of typhoid fever. In 1869, the year in which typhoid was first distinguished from other forms of fever, the death-rate in London from this disease was 34 per 100,000 inhabitants, compared with a death-rate in Munich of 149 per 100,000 inhabitants. By 1895, the death-rate in London was 14, while in Munich, where Pettenkofer had been working for forty years, it was only 3 per 100,000 inhabitants. Although the decrease in the mortality returns from this disease was ascribed in Munich to the purer water-supply from the Pettenkofer water-works and other sources, the change was more probably due to the improvement in the drainage system. Porous cesspits, which had for centuries received the city drainage, had been replaced by order of the authorities in 1853 by those lined with cement, and thereby an immense improvement in the health conditions of the people was effected.

Pettenkofer's activities in experimental hygiene extended over a wide field. He was Chairman of the Royal Commission on Cholera in 1854, published

his first report on this subject in 1855, and another in 1857, while his investigations were continued into the ninth decade of the century. In 1856, being elected an ordinary member of the Academy of Sciences, he took his seat in that body as a chemist and not as a hygienist. 1858 saw the publication of his first strictly sanitarian work in the *Report on the Ventilation of Dwelling Houses*, and this, in an age when the importance of fresh air was held of no account, awoke public opinion to the need of reforms. In the same year he published the account of a method he devised for estimating the amount of carbon dioxide contained in air, one of his most extensively used discoveries. In 1861, in collaboration with his celebrated pupil, Voit, he was the first to estimate, by means of a specially devised respiration apparatus, the amount of proteins, fat, and carbohydrates broken down in the body, and with Voit he carried out many researches in dietetic chemistry. The hygiene of clothing, too, received his attention, and the connection of the soil around dwellings with the health of the inhabitants. To a certain extent he revived the old theory, so prevalent in Sydenham's day, of the dependence of contagion on atmospheric conditions and on the escape of poisonous gases from the ground. It was owing to Pettenkofer's powerful influence that the first Chair of Hygiene, of which he became the first occupant, was established in Munich University in 1866. He held this Chair for nearly thirty years, and during that time Munich became a centre of world-wide influence in hygiene, attracting pupils from all parts of Europe. It was his teaching which led Germany to adopt a system of medical government on scientific lines, to disinfect her towns, to supply her

people with clean drinking water, to establish Chairs of Hygiene in her universities, and to prepare the way for the great strides in sanitary science which the last quarter of the nineteenth century witnessed.

Pettenkofer's writings, like his work, dealt with every aspect of hygiene, and as this was a department new to medicine, his papers were not at first accepted by the medical journals, for, as the founder of a new branch of medicine in Germany, he encountered the opposition of his profession. To obtain the publicity he required, he founded with Voit, Buhl and Radlkofer, the *Zeitschrift für Biologie* in 1865, and continued to co-edit it till 1888. In 1882 he published with Ziemssen the *Handbuch der Hygiene*, and in 1883, with Hofmann and Forster, founded the *Archiv für Hygiene*. In these papers most of his works appeared. Being an excellent speaker, his addresses at sanitarian conferences were always listened to with deep interest. His speech was vigorous and fluent; he defended his ideas with indomitable energy and with all the conviction that his ardent belief in his teaching warranted. His influence as an authority in Hygiene was marked by the large number of distinguished men who came to hear him, not only from Germany, but also from abroad, and his genial, sociable nature made his house in Munich the meeting place of many celebrated scientists.

The erection of the magnificent Institute of Hygiene, begun in 1872 and finished in 1878, of which Pettenkofer was appointed Director, is a fitting monument to the work of this great pioneer in the city that he served so faithfully. Nothing could entice him from Munich, where his work in the cause of preventive medicine had begun. Neither

the Chair of Hygiene at the University of Vienna, which was offered to him in 1872, nor the first Directorship of the Imperial Institute of Hygiene in Berlin, where Bismarck tried to attract him in 1876, could tempt him away from Munich. His heart was with his work in that city, and he remained there as long as his physical strength lasted.

In 1883 he received the highest distinction obtainable in Prussia, the *Ordre pour le Mérite* in Science and Art, to which hereditary nobility is attached, and in 1899 he was appointed President of the Bavarian Academy of Sciences.

Although Pettenkofer lived to see the birth of the germ theory and the great advances in the science of bacteriology which were made in the eighties, he never accepted the discovery that infection was conveyed by bacteria, nor foresaw the new impulse it gave to the science of experimental hygiene. So opposed was he to the whole idea, that when Koch discovered the bacillus of cholera in 1883, Pettenkofer is said to have swallowed a culture of virulent bacilli in order to prove their harmlessness.

In 1890 he lost his wife and, when failing health obliged him to leave his work in 1894, he retired to his beautiful country home at Seeshaupt, where he could see from his garden the snow-clad Bavarian Alps, and receive his visitors whom he delighted to row over the lake. He was held in great veneration by his fellow-countrymen and by sanitarians all over the world, and many distinguished men came to see him here. But towards the end of his life, he suffered much from fits of mental depression. Death had depleted his family circle for, in addition to his wife, he lost his highly-gifted eldest son, his second son and a daughter, and

these tragic events deepened the mental gloom that enforced idleness after a crowded life had brought him. He became a prey to the thought that his mind was failing, and told his friend Voit that he would one day take his life. In January 1901, septic inflammation of the throat set in from which he only slowly recovered. The pain increased his depression of spirits; his condition seemed unbearable to him, and at the advanced age of eighty-three he ended his life with a revolver shot.

All Munich mourned the loss of one who was universally regarded with affection and esteem by reason of his long devoted service to the city.

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EDMUND ALEXANDER PARKES, M.D., F.R.S.

1819-1876

Throughout Europe Edmund Parkes is acknowledged as the founder of modern military hygiene, and our Army Medical School was indeed fortunate in having the services of such a man at its command on its formation. For, in addition to the scientific and practical value of his work, he was a great teacher and by the power of his personality exercised a far-reaching influence on the band of followers trained under him at a time when the general teaching of hygiene was in its infancy. He was a man universally beloved for the innate goodness of his character, his selflessness, and his single-hearted devotion to the public service.

Born at Bloxham in Oxfordshire, on the 29th of March 1819, Edmund Alexander was the son of William Parkes of Warwick, and was related on his mother's side to Josiah Wedgwood, her father, Thomas Byerley, being a nephew and partner of the famous potter. His mother was a woman of some ability and the author of several books of a useful nature, one of which, entitled *Domestic Duties*, passed through several editions. He was, like other famous men before him, notably Charles Lamb and Coleridge, a Bluecoat Boy. On leaving Christ's Hospital, he entered the Medical Faculty at University College,

Edmund Alexander Parkes
1819-1876

From a photograph, reproduced by permission of the Royal Society of Tropical Medicine and Hygiene.

London, and in the laboratory of his uncle, Dr Anthony Todd Thomson, acquired a zeal for research and considerable manual dexterity. At a very early age he was able to take his uncle's place in his absence in lecturing on materia medica and medical jurisprudence. In his first year, he was exhibitioner medallist in anatomy, physiology, chemistry and materia medica, and in 1841, when he took his degree of M.B., was medallist in physiology and comparative anatomy and took honours in medicine. Sir William Jenner, who attended the same classes with him at University College, describes him in his student days as distinguished by brightness and cheerfulness, amiability and unselfish willingness to help others at any cost of trouble to himself. He possessed an extraordinary power of acquiring information, and studied every subject in the medical course with equal application, sparing no effort till he was completely master of all the facts. This characteristic remained with him all his life; whatever work he had in hand he gave to it his whole mind, studying it from every aspect. And the result was very evident in the wide range of the knowledge he brought to bear on all the work which came his way in the course of his brilliant career, and never more so than in his first two publications, the outcome of his work in India. For, in 1842, he joined the Army and went as assistant surgeon with the 84th (York and Lancaster) Regiment to Madras, and later to Moulmien in Burmah. The studies that he made there of dysentery and cholera, of which he witnessed two violent epidemics, involved the collection of the most careful clinical records and *post-mortem* details; and this he carried out in the midst of the hot

weather, in addition to the unremitting attention he gave to the sick during the progress of acute epidemics. The papers were not published until after his return to England in 1845, but the fund of information that went to their making was accumulated in India. The subject of the first, *Remarks on the Dysentry and Hepatitis of India*, he chose as the subject of his thesis when he took his M.D. of the University of London in 1846; and the second, *Researches into the Pathology and Treatment of the Asiatic and Algide Cholera*, was published in the following year. Of these two papers, Sir William Jenner said: "These works prove, more than all the many honours he obtained at his College and University, the amount of work he must have performed as a student—the real knowledge he possessed, knowledge only to be acquired by hard, continuous and unremitting work, and the varied character of that knowledge, chemical, microscopical, anatomical and clinical. These works, had they been written by one who had filled the post of physician to an hospital for years, would be held to give evidence of high merit in their author; but when it is remembered that they are the productions of a man who had only then closed, and at an early age, his college days, their merit must excite our surprise. . . . Apart from the evidence they afford of Parkes's energy, power of work, and the wide extent of his knowledge, they prove that he possessed even then originality of mind, and rare powers of accurate observation. . . . These two works are among the most remarkable in medical literature."

On his return from India, Parkes resigned from the Army, and settled in practice in London, first

in Upper Seymour Street, and afterwards in Harley Street. He married in 1850, Miss Mary J. Chattock of Solihull, near Birmingham, but had no children. His wife was delicate and his own health far from robust, and for this reason he did not stay long enough in London to acquire a large practice, which his acute powers of diagnosis, and the whole-hearted confidence of his colleagues would certainly have brought him in time. But two serious illnesses, pneumonia and phlebitis, combined with his wife's desire for a country life, led him eventually to consider leaving the town. In the meantime he was appointed in 1849 Professor of Clinical Medicine at University College and Physician to University College Hospital, posts which he held till 1859. At this time he contributed largely to the medical press. Two papers on cholera were published after the cholera epidemic of 1848-49 in London, and in the same year "Diseases of the Heart" appeared in the *Medical Times*, a journal in which many of his articles on a variety of subjects were published. In it are to be found his clinical lectures, delivered at University College Hospital from 1850 to 1857, which form valuable records of his clinical work. He was an interesting lecturer, possessing lucid powers of exposition and devoting to the subjects of his lectures the same painstaking attention in preparation which had characterised all his work as a student. The power he exerted over his class in inciting them to a high conception of their duties as students of a learned profession, on the right exercise of which so much depended, was very remarkable. He was, as a colleague said of him, "such an ardent, honest, and indefatigable searcher after scientific truth himself, and

for truth's sake and the general good only, that his example as much as his teaching served to excite a kindred love of the same pursuit in others."

In 1851 he edited a new edition of Thomson's *Diseases of the Skin*, and during the time he held the Chair of Clinical Medicine at University College, amassed the large collection of material which went to form his book on *The Composition of Urine in Health and Disease and under the Action of Remedies*, a work which contained a most careful detailed account of all that was then known on the subject, and became, when it was published in 1860, the standard work of the day. From 1852 to 1855 he edited the *British and Foreign Medico-Chirurgical Review* most ably, and in 1855 delivered the Gulstonian Lectures on Pyrexia at the Royal College of Physicians, publishing them in the *Medical Times*.

When public indignation at the deplorable disasters suffered by the troops in the Crimea was at its height in 1855 owing to the complete breakdown of the organisation for providing for the wounded and the sick, the Government were obliged to take emergency measures, and it was decided to erect a temporary hospital to relieve the pressure on the hospitals at Scutari. Mr Sydney Herbert, Secretary of State for War, selected Parkes, on account of his experience of epidemics in India, to choose the site, superintend the arrangements for building and take charge of the hospital at Renkioi on the Asiatic bank of the Dardanelles where Brunel, the engineeer, soon erected thirty wooden huts, containing two wards each, with accommodation for 1500 beds. The story of Parkes's successful administration of the hospital in the most difficult and distressing circumstances is told in the

report he published at the end of the war. From the time it was opened in October 1855, until the Allied Armies left the Crimea in July 1856, there were 1331 cases admitted, and they were for the most part cases of dysentery, spotted typhus, enteric and relapsing fevers, which decimated the armies in the days when the means of the transmission of infection was still unknown. In his report Parkes speaks highly of the discipline observed in the hospital under the most trying circumstances, and of the devoted service of the nursing staff.

As a consequence of the disasters brought about by the lack of organisation for the sick in the war, a Royal Commission was appointed to report on the sanitary condition of the Army, and following its recommendations, the first Army Medical School was founded at Fort Pitt, near Chatham. In the negotiations which preceded its formation, Mr Sydney Herbert constantly sought Parkes's advice as to the constitution of the new school and, when it was formed in 1860, offered him the most important position in it, that of Professor of Military Hygiene. Parkes, who was anxious to leave London, and enthusiastically interested in the dawning science of hygiene, readily accepted the Chair and resigned from University College. The new post was an onerous one, for the science with which it was concerned had first to be organised, and in a great measure created. Much had been done by former workers in hygiene, but the knowledge acquired had never been brought together and made available for practical use. There was no man better fitted to fill this important post than the man upon whom the choice of the Secretary for War had fallen. The articles he had published in

the *British and Foreign Medico-Chirurgical Review* showed how completely he had mastered the subject of hygiene from every point of view, missing nothing that had been written about it either at home or abroad. His great ability as a teacher, too, singled him out as the ideal head of a new school. In writing of this aspect of his work, a colleague, Sir Thomas Longmore, said: "The influence Dr Parkes exerted on those who had the advantage of his tuition before entering the military services of the country, and thence indirectly on the public services themselves, was beneficial to an amount which can hardly be over-estimated."

In creating the system of instruction at the Army Medical School, Parkes founded the modern science of military hygiene. His "Annual Reviews of the Progress of Hygiene," published in the *Army Medical Department Blue-Book* up till the year of his death, constitute a most valuable record of all the activities of the new science both at home and on the Continent, and are remarkable, as Sir William Aitken has said, for the variety, clearness and soundness of the information conveyed. They contributed largely to that necessary prelude of any measures of sanitary reform, the education of the public in matters of hygiene.

In 1863 the Army Medical School was transferred to the Royal Victoria Hospital at Netley, and in 1864 Parkes published his *Manual of Practical Hygiene*, a famous work which became the model for future writers on this subject. To the compiling of this book there went an enormous amount of labour and energy, and many laboratory experiments carried out over long periods, Parkes himself testing the truth of every statement the book contains. In nine years

it had reached its fourth edition and was enlarged to include civil as well as military hygiene. It was translated into many European languages and by 1891, after Parkes's death, it reached an eighth edition. In his laboratory at Netley, in addition to the ordinary practical work of his class, he conducted a series of experiments on various subjects calculated to advance the science of hygiene, and more especially in its application to the life of the soldier. Many experiments on the various values of diet were carried out, and in three papers published in the *Proceedings of the Royal Society* between 1867 and 1871, he described the "Effects of Diet and Exercise on the Elimination of Nitrogen." He contended that the elimination of urea is not dependent on the amount of muscular exercise performed, but on the consumption of nitrogenous food consumed. His experiments on the effects of alcohol, a subject which had interested him ever since he was in India with the 84th Regiment, in whose ranks there were 400 total abstainers, were published in three papers in 1870, 1872, and 1873, entitled "Experiments on the Effects of Alcohol on the Human Body," and "Experiments on the Action of Red Bordeaux Wine on the Human Body," and the "Influence of Brandy on the Body Temperature, Pulse, and Respiration of Healthy Men." He also published a paper on a "Comparative Inquiry into the Effects of Coffee, Extract of Meat, and Alcohol on Men Marching," and a report on the value of the spirit ration for troops on evidence collected during the Ashanti Campaign. The substitution of the valise equipment for the cumbrous pack with which the soldier was burdened was largely due to Parkes's initiative as a member of General Eyre's Pack Committee.

Parkes was a man without worldly ambition, and he refused to accept from the Crown any recognition of his great services to the nation. The reward he coveted most was the advancement of truth in medical science. He was elected a Fellow of the Royal Society in 1861, and was a member of its Council. He served on the Senate of the University of London, and in 1863 was appointed Crown Member of the General Medical Council, a position which gave him the opportunity of bringing his great influence and wide experience to bear on the improvement of medical education. His criticism that the General Medical Council had been in existence for ten years before it had even considered the state of medical education in the United Kingdom had the effect of drawing much-needed publicity to this matter. In a series of papers published in the *Lancet* of 1868, entitled "A Scheme of Medical Tuition," he called attention to the insufficiency of medical examinations, shown by the ignorance of many students, passed by the Licensing Bodies, who had come before the Army Examining Board. He laid stress on the value of the practical study of chemistry and physiology in the laboratory, and on the teaching of methods of physical examination before clinical work was undertaken, and many other reforms which have since been adopted. His criticisms led to the appointment by the General Medical Council of a Committee on Medical Education. His views were, however, like those of many other reformers, in advance of his time and opposed to tradition; but some of the recommendations of the Committee were adopted by the Licensing Boards, such as the institution of class examinations in medical schools, the regulation that

every student should serve as a clerk or a dresser, and that students should be examined clinically. Parkes was in favour of the admission of women to the medical profession.

In 1871, at a time when the sanitary inquiries instituted by Chadwick in the first half of the century were becoming more and more frequent owing to the overcrowding and insanitary conditions created by the steady influx of workers from the country to the towns, Parkes was appointed to make a report on the sanitary state of Liverpool with Dr Burdon Sanderson of University College. Typhus was then ravaging the country, and Liverpool constituted one of the best breeding grounds for its spread, for the disease increased in direct proportion to the overcrowding of the locality.

In 1873 Parkes lost his wife after a severe illness, and this blow, combined with the strain of his increasing activities, told severely upon his health, which failed in the winter of 1875. After a long illness, proving to be of a tubercular nature, he died on the 15th of March 1876 in his fifty-seventh year, at his home, Sydney Cottage, Bittern, near Southampton, and was buried by the side of his wife at Solihull, Birmingham.

At the time of his death he was engaged in writing the Harveian Oration which he had been invited to deliver to the Royal College of Physicians, an honour he greatly appreciated. His unfinished address was read to the Fellows by his friend, Sir William Jenner, in July 1876. His early death occasioned universal grief among his colleagues and fellow-workers. Apart from his intellectual worth and his untiring labours in the cause of science, the greatness of his moral

character was appreciated far and wide. "The excellence of his life was so evident," said Sir William Jenner, "his work . . . performed so unostentatiously and manifestly from such high motives, . . . that few of his fellow-students could escape being better men from associating with him." The well-being of the Army Medical School which he had founded was his last thought, for on his death-bed he expressed to Sir William Jenner his earnest wish that he would exert his influence to stay the hands of those who, through ignorance of the value of the School, might possibly wish to curtail its usefulness, or even to destroy it. Impressing upon him the worth of all his colleagues and the value of the work they were doing, he said: "A body of men so able and so well fitted for their duties, if once dispersed, could never again be collected."

But not only in his own land was there grief at his passing. Baron Mundy, Professor of Military Hygiene in the University of Vienna, gave expression to the widespread regret in Europe at the news of his death when he said: "All the Armies of the Continent should at parade lower their standards craped, if only for a moment, because the founder and best teacher of military hygiene of our day, the friend and benefactor of every soldier, Edmund Parkes, is no more."

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Louis Pasteur
1822-1895

From the etching after Albert Edelfelt.

LOUIS PASTEUR

1822-1895

Jean Joseph Pasteur, the father of the genius who made this name immortal, came of a working class family of old descent, once tillers of the soil, but for the two generations before his day, tanners in the south of France. Jean Joseph served in the Peninsular War in a regiment of the line distinguished for its fine record, and in it rose to the rank of Sergeant-Major and received the Cross of the Legion of Honour. Disheartened at the turn events had taken on Napoleon's defeat, he returned to his native town of Besançon and took up the trade of tanner. In 1815 he married Jeanne Etiennette Roqui, who like himself was descended from an old family whose lineage can be traced as far back as 1555, the Roquis being workers in the vineyards round the countryside. She is described as an active, imaginative woman, of a careful disposition and much absorbed in thought. Jean had not much education, for it was then considered sufficient if a man could read the Emperor's bulletins; but he appears to have been endowed by nature with a keen sense of values, for he strove all his life, amid the toils of a tannery, to improve himself in the things of the mind, and for his children, he coveted more than anything else a good education.

Louis Pasteur was born at Dôle on the 27th of December 1822. After the birth of two daughters,

the family moved and finally settled in the small town of Arbois, where a better tannery offered a surer means of livelihood, and Louis attended classes at Arbois College. At school he was not considered more than a good average pupil, hard-working and very quiet, but the headmaster was attracted by qualities in him which he thought worthy of encouragement. The boy's reluctance to commit himself to making any statement before he was convinced of its truth, his industry, his caution, combined with a lively imagination, seemed to the master, if others put them down to a slow wit, to be habits of mind which should be cultivated, and, at his suggestion, Louis was sent to Paris to prepare for the entrance to the *École Normale*, a school founded in 1808 by Napoleon I. for the training of teachers. But Paris was far from Arbois, and Louis, a reserved, sensitive boy of fifteen, taken from a family who were warmly attached to one another, was overcome with homesickness. He felt that only a "whiff of the tannery yard" could cure him, and, although he fought valiantly against this nostalgia, it became evident to his masters that he was falling into low spirits, and eventually he was sent home. He got a place in Besançon College as a pupil teacher, and in 1842 sat for the entrance for the *École Normale.* Although he passed the examination, the place he took was too low to satisfy him, and he decided to try again in the following year. It is interesting to note that in chemistry, the examiners classed him as "mediocre." In October 1842, he went to Paris for the second time, taught at the Barbet Boarding School for a modest salary, while he attended the lectures of the celebrated chemist M. Dumas, at the *Sorbonne.* In

a year's time he was admitted fourth on the list to the *École Normale.*

The first discovery made by Pasteur, the discovery of the molecular dissymmetry of tartaric acid, attracted the attention of the scientific world. Tartaric acid was first discovered in the thick crust which forms in wine barrels, by a Swedish chemist in 1770, and another form of it, by some named paratartaric acid, by others racemic acid, was accidentally obtained by Kestner, an Alsatian manufacturer, whilst he was preparing some tartaric acid in his factory at Thann in 1820. Kestner was unable to reproduce the racemic acid, and, although many chemists came to Thann to study this mysterious substance, the problem of its composition remained unsolved. Kestner had, however, kept a stock of what he had accidentally prepared. Pasteur had been studying the tartars for some time, when M. Biot, the famous French chemist, then an old man, communicated a paper by the German chemist Mitscherlich, to the *Académie des Sciences*, in which Mitscherlich gave an account of his work on the tartars and described his discovery that while a solution of tartaric acid, when tested in the polariscope, deflected the plane of a ray of polarised light, a solution of racemic acid, a substance of crystalline form similar to tartaric acid, had no action upon the ray of light. It was neutral. Why should the one solution, of like composition with the other, rotate the plane of light and the other not? To this problem Pasteur supplied the answer. Examining the tartaric acid crystals through his microscope, he discovered on their edges little faces, which neither Mitscherlich nor that expert in physics, de la

Provostaye, whose work Pasteur had just been studying, had observed. And from the position of these faces which inclined to the right, he concluded that the crystals must be what is called dissymmetric, *i.e.*, one of a pair, and that somewhere the corresponding crystal, with its face inclined to the left, must exist. He looked for this left-handed crystal in racemic acid, but he found that this acid contained both crystals, those with faces inclining to the right and those with faces inclining to the left. Very carefully he picked out the crystals, separating the right-handed from the left. Placing each of these separately in the polariscope, he found that they deflected the plane of light, the one to the right hand, the other to the left. Then mixing an equal number of right-handed and left-handed crystals, he placed them together in the polariscope and found that they had no action on the ray of polarised light, for they neutralised each other. It was clear, then, that racemic acid was composed of equal quantities of right and left-handed crystals, and the problem of the optical inactivity of this substance which had confounded the great chemist Mitscherlich, was solved. In his excitement, his biographer tells us, Pasteur rushed out of the laboratory and seizing the first man he met, took him to the Luxembourg Gardens to tell the story.

Pasteur was twenty-six when this discovery was made. His joy in it was overcast by the sudden death of his mother, to whom, as to all the members of his family, he was very devoted. But it drew upon the young man the eyes of the scientific world of Paris. The old chemist Biot, always sceptical of any new discovery, summoned him with his crystals to perform the experiment before him, and when he

was convinced of its truth he became, and remained for the rest of his life, one of Pasteur's most ardent adherents. At a later date, Biot arranged a meeting with Mitscherlich, at which Pasteur gave a demonstration of his work, and was introduced to many illustrious members of the *Académie des Sciences.* He was not content, however, with having explained the relation between optical activity and the crystalline forms of the tartars, but wished to produce racemic acid artificially. The difficulty of finding this very rare substance in its crude state retarded his experimental work, and when he heard from Mitscherlich's friends that racemic acid could be obtained at the works of a manufacturer in Leipzig, he could not rest till he made the journey in search of the treasure. In 1849, after having been appointed Professor of Physics at Dijon, a post which interrupted his researches in Paris and removed him from the society of many distinguished colleagues, he was appointed to the Chair of Chemistry at Strasbourg. Here he married Marie, the daughter of M. Laurent, Rector of the Academy of Strasbourg, a wife who shared his enthusiasm for science, his anxieties and his hopes, and who devoted her life to his welfare. To her, writing from Leipzig, where his search for racemic acid had begun, he said: "I have not left the laboratory for three days, and I know nothing of Leipzig but the street which goes from the *Hotel de Bavière* to the University." But the racemic acid in Leipzig was not sufficiently crude for his purposes, and he continued his search in Freiburg and many other towns, until at last in Vienna, he found the raw article. Pasteur had spent five years on his researches on the tartars. It was his habit not to proclaim his

results till he could support them with the most rigid proofs. "I am bound to eliminate every cause of error," he said, "every perturbing influence; I can maintain my results only by means of the most irreproachable experiments." He announced his success in obtaining racemic acid artificially in 1853. A telegram to M. Biot in Paris bore the cryptic announcement: "I transform tartaric acid into racemic acid"; but writing to his father, whom he always kept informed of his work, he said: "Here is at last that racemic acid (which I went to seek at Vienna) artificially obtained through tartaric acid. This discovery will have incalculable consequences." For this he was awarded the red ribbon of the Legion of Honour, and received a prize of 1500 francs from the Pharmaceutical Society, half of which sum he devoted to the equipment of his laboratory in Strasbourg.

In 1854 Pasteur was made Professor and Dean of the Faculty of Science at Lille. Here in the centre of an industrial town in a country of distilleries, the opportunities for research on the subject of fermentation, that now obsessed him, were manifold. "In the fields of observation," he said to his pupils, "chance only favours the mind which is prepared," and the record of his life is one long illustration of this remark, for the problem had only to be set for this man of genius to find the answer. When in 1856 complaints were made in Lille of failures in the manufacture of alcohol from beetroot, Pasteur went down to the factory himself daily to study these failures, returning laden with fermentation juices which he examined under a microscope in his laboratory. The origin of life, that much discussed subject, centuries old, was what interested him now. Were bacteria

produced without parents, arising from some disturbances in putrefying matter itself? The whole subject was at this time very obscure, but the doctrine of spontaneous generation for the most part held the day. It was the orthodox belief and was defended with all the zeal and bigotry that the orthodox of every age bring to bear on the authors of any new doctrine. In the seventeenth century micro-organisms had been discovered, and experiments with gauze-protected meat had, in fact, disproved the theory of spontaneous generation; but these experiments were not followed up to their logical conclusions, and their application to the facts of everyday life was overlooked. Studying the souring process in milk, Pasteur observed under the microscope some tiny globules floating about in a grey substance. Separating the grey matter, he put some of it in a liquid suitable for its growth, and watched for the result. It grew and produced a ferment, for he had indeed isolated the living germ which, acting upon milk, causes fermentation. In 1857, after exhaustive researches, he presented to the Lille Science Society his paper on lactic fermentation, and three months later read it to the *Académie des Sciences* in Paris. This paper was the foundation of the new science of bacteriology, so familiar to us to-day, but at that date calculated so to upset men's current notions, that the controversy it set going lasted in some degree to the end of Pasteur's life.

In the same year Pasteur received the appointment of Administrator and Director of Scientific Studies in the *École Normale* in Paris. Biot, his old master, protested against this appointment, thinking the authorities were wasting his fine talents in routine duties: "They have made of him an administrator,"

he said, "let them believe that he will administrate." But Pasteur, the most conscientious of men, fulfilled all his duties with scrupulous care, while he worked unceasingly in the garret in the Rue d'Ulm, which was all that was afforded him for a laboratory, on the subject of alcoholic fermentation, and in December 1857 he presented a paper to the *Académie des Sciences*, showing that "the deduplication of sugar into alcohol and carbonic acid is correlative to a phenomenon of life, an organisation of globules."

In 1860 the *Académie des Sciences* awarded him the prize for Experimental Physiology, and in awarding it, Claude Bernard, the famous physiologist, alluded to "the great physiological interest" of the results of Pasteur's experiments on alcoholic fermentation, lactic fermentation, and the fermentation of tartaric acid, with their inevitable reaction on the profession of medicine. Pasteur himself, writing to an old school friend at this time, said: "I am pursuing as best I can these studies on fermentation which are of great interest, connected as they are with the impenetrable mystery of Life and Death. I am hoping to mark a decisive step very soon by solving, without the least confusion, the celebrated question of spontaneous generation. . . . There is so much obscurity, together with so much passion, on both sides, that I shall require the accuracy of an arithmetical problem to convince my opponents by my conclusions." And, writing to his father, he spoke of "the future reserved to those great results, so unexpected, and opening such an entirely new outlook to physiology."

In 1862 he was elected a member of the *Académie des Sciences* by 36 votes out of 60. Pouchet, the Director

of the Natural History Museum of Rouen, was one of Pasteur's chief opponents, and he declared that he was prepared to demonstrate that "animals and plants could be generated in a medium absolutely free from atmospheric air, to which no germ of organic bodies could possibly have been brought by air." Pasteur, on the contrary, maintained, and had proved experimentally, that any easily corrupted liquid, such as yeast water, could be kept pure indefinitely when enclosed in a flask, brought to boiling point in order to kill any germs already in it, and sealed. Moreover, he proved that the same liquid could still be preserved in a pure state by keeping it in an unsealed bottle with a curved neck, because the air which then reached it had deposited its germ-laden dusts on the curved neck of the bottle. He demonstrated this at a public lecture given in the Sorbonne in 1864, when all Paris was present, the fashionable and literary worlds now being interested in this momentous question of spontaneous generation, which was causing such an upheaval in the world of science. Holding up his two flasks of liquid, the one straight-necked, the other curved, Pasteur addressed his spell-bound audience: "Why does one decay and the other remain pure?" he asked. "Because in the first case the dusts suspended in the air and their germs can fall into the neck of the flask and come in contact with the liquid and develop; thence microscopic beings. In the second flask it is impossible, or at least extremely difficult, that dusts suspended in the air should enter the vase; they fall on its curved neck . . . everything in the air save its dusts can easily enter the vase. . . . And, therefore, gentlemen, I can point to that liquid and say to you, I have

taken my drop of water from the immensity of creation, and I have taken it full of the elements appropriated to the development of inferior beings. And I wait, I watch, I question it, begging it to recommence for me the beautiful spectacle of the first creation. But it is dumb, dumb since these experiments were begun several years ago; it is dumb because I have kept it from the only thing man cannot produce, from the germs which float in the air, from Life, for Life is a germ and a germ is Life."

For the next six years that other great genius, Lister, was working out with such success in Glasgow and in Edinburgh his method of antiseptic surgery, founded on Pasteur's germ theory; yet in 1870, when the war between France and Germany broke out, Lister's methods were not generally applied to the wounds of the French soldiers, and the dust-laden air brought in its train as of old, septicæmia, erysipelas and gangrene, which carried off in their thousands the young men of France.

In the years 1865 and 1866 Pasteur lost two daughters from typhoid fever and his father died at Arbois. At this time the Ministry of Agriculture sent him to Alais, a centre of the silk-worm industry, to study the silk-worm disease which for twenty years had been ruining the trade. Pasteur's protest of his unfitness for this task, in that he had never seen a silk-worm, was disregarded by the Minister, whose action was amply justified by the result. The silk-worm or corpuscle disease was called *pebrine* from the resemblance of the spots with which the worms were covered to specks of pepper, and the silk-manufacturers had exhausted every conceivable method of obviating the infection by disinfection, fumigation, by using

only guaranteed pure seed in breeding the worms, but all in vain. Ruin stared them in the face. After numerous experiments on the seed, both guaranteed and unguaranteed, Pasteur concluded that the disease developed chiefly at the chrysalid and moth stage, according as the seed itself had been slightly or heavily infected. Its existence had therefore been overlooked in the guaranteed seed, in which it remained dormant until the moth stage was reached. In order that they might discover earlier the existence of the symptoms, Pasteur taught the manufacturers to hasten the development of the moths by raising the temperature in which they were hatched. They were then examined through the microscope and destroyed if unhealthy. "The sickly character is then so easy to detect," he said, "that a woman or child can do it. If the cultivator should be a peasant without the material required for this study, instead of throwing away the moths after they have laid their eggs, he can bottle a good many of them in brandy and send them to a testing office or to some experienced person, who will determine the value of the seed for the following year." "The corpuscle disease," said Pasteur, "is as easily avoided as it is contracted." All countries interested in the manufacture of silk benefited by his recommendations, and Italy especially carried out his methods with great success.

By his studies on wine, he saved his own country millions of francs, showing the manufacturers how, by heating the wine, the diseased parasites could be killed, and the wine itself improved rather than deteriorated in the process; and he showed the vinegar makers how they could increase the speed at which vinegar fermented, making of a long process,

a short one. Napoleon and the Empress Eugenie inquired of Pasteur why he had not turned these researches into a source of profit for himself. His reply was characteristic of his attitude to life: "A man of science would complicate his life, the order of his thoughts, and risk paralysing his inventive faculties," he said, "if he were to make money by his discoveries."

In May 1867, he received the Grand Prize Medal for his work on wine. It was conferred by the Emperor himself in the *Palais de l'Industrie* amid a brilliant assembly.

After returning from Alais, Pasteur, at the age of forty-six was struck down by a cerebral hæmorrhage from which he very nearly died, and which left him with a slight paralysis on the left side. His recovery was slow, and before it was complete, the Franco-Prussian War broke out. With difficulty he was persuaded to go to Arbois, and there from a sick-bed he carried on with the efficient help of his family such researches as he could. The war, however, nearly broke his heart. He returned the honours he had received from Germany in recognition of his scientific work, and refused, even many years afterwards, to accept any honorary degree from that country. And in order that France should not occupy an inferior place to Germany in the manufacture of beer, he studied the brewing industry for the five years that followed the war, and published in 1876 his *Études sur la Bière.*

In 1873 he was elected an Associate of the *Académie de Médecine* by a majority of only one vote. He thus obtained the opportunity he had long desired of bringing home to the medical world within its own domain the application of his discoveries to

the profession. This man, a chemist, not a physician, interrupted the medical discussions to point out to an amazed and incredulous assembly the micro-organisms they would find in the diseased bones of children; and when they laughed at him for his statement that a microbe, and a microbe alone, was responsible for the infection of puerperal fever in childbirth, he drew on the blackboard an exact representation of the microbe to be found in the blood of a patient suffering from this disease, saying to his astonished hearers, "Tenez, voici sa figure." When he read his celebrated lecture on the Germ Theory in 1878, addressing the surgeons, he said: "If I had the honour of being a surgeon, convinced as I am of the dangers caused by the germs of microbes scattered on the surface of every object, particularly in the hospitals, not only would I use absolutely clean instruments, but, after cleansing my hands with the greatest care and putting them quickly through a flame, I would use only lint, bandages and sponges which had previously been raised to a heat of 130° c. to 150° c.; I would only employ water which had been heated to a temperature of 110° c. to 120° c." The *Académie de Médecine*, accustomed to long and weighty discourses upon the theory of disease, became inured to some practical demonstrations before Pasteur's day was done. He once had occasion to bring to the *Académie* a cage of fowls to demonstrate the fact that, although a hen is proof against the germ of anthrax because the temperature of its blood, being higher than that of mammals, does not favour the growth of the germ, yet it will contract the disease if its temperature is artificially lowered by means of a cold bath; and, more than that, it will recover again if removed from

the bath and warmed before the disease is too far advanced. This experiment was carried out before the august assembly because one of its members had defied him to produce anthrax in a hen, and Pasteur, no doubt, had a twinkle in his eye as he immersed the hen in the cold water on so grave an occasion.

When he had discovered a protective vaccine against anthrax, after a series of brilliant researches, he was provided by the agriculturalists with sixty sheep for practical demonstration. Twenty-five of these he vaccinated with his protective vaccine, twenty-five he left unvaccinated and therefore unprotected, and ten he kept for comparative purposes. He then administered a dose of the anthrax germ to the fifty sheep. A vast multitude of farmers, veterinary surgeons and doctors came to the farm at Pouilly le Fort to witness this experiment, and the fame of it was spread over Europe, for anthrax was a disease very prevalent on the Continent. "The twenty-five unvaccinated sheep will all perish," said Pasteur, "the twenty-five vaccinated ones will survive." And, as he had said, so it was, and the twenty-five survivors compared favourably with the ten which had been untreated.

In 1880 he took up the study of chicken-cholera and in the course of this research, made a discovery which, in its eventual application, altered the whole course of clinical treatment in medicine. We are quite familiar to-day with the small glass bottles of cultures of gradually increasing degrees of strength sent out from the laboratories, which give us immunity, with no ill effects, from so many diseases; but before Pasteur turned his attention to chicken-cholera, the virulence of his prepared cultures had been of one

strength. His chief concern had been to find a suitable medium in which to cultivate his germs. A lucky accident drew his attention to a means of procuring attenuated doses. He was inoculating some hens with a culture which had been overlooked and laid aside for a few weeks unused, and while waiting for his hens to die, as they did when inoculated with a new culture, he was surprised to find that, although they became ill, they recovered. Subsequent researches showed that the action of oxygen on the culture that had been laid aside had reduced its strength, and thus the way was shown to a means of producing an attentuated culture of any desired strength by allowing a longer and longer interval to elapse before the cultures were used. He could then inoculate his animals with a mild dose, increasing it gradually until they became able to resist even a dose of virulent microbes at full strength. Conversely, he discovered by his studies on anthrax in 1881 that he could increase the strength of the micro-organism by passing it through a succession of guinea-pigs, whose blood supplied a suitable medium for its growth, until he got it up to full virulence.

For this discovery Pasteur was awarded the Grand Cross of the Legion of Honour, and in 1882 he was elected a member of the *Académie Française*, that eminent body composed of forty of France's most honoured sons. This recognition of his work gave him intense pleasure. "I had never in my life," he said, "contemplated the great honour of entering the *Académie Française*—an invitation so glorious for Science and so flattering to myself."

The last years of his life were given up to a long series of researches on hydrophobia, that most terrible

scourge, for which no remedy then existed. After an exhaustive and inconclusive search for the microbe of rabies in the saliva of animals afflicted with this disease, he sought and found it in the spinal cord and the brain. By taking his virus from the spinal cord of a dog infected with rabies, and drying it in a phial of dried air until its virulence was reduced, he produced his attenuated dose and could then inoculate a healthy dog with doses increasing in strength until the animal became immune from any ill effect even from the bite of the most rabid beast. In 1885 he made his first human experiment on Joseph Meister, a child of nine, who was brought to the laboratory terribly bitten by a mad dog. The experiment was entirely successful, but cost Pasteur intense anxiety until the period of incubation was over. Thereafter the stream of patients arriving at the Paris laboratory became so large that special arrangements had to be made to treat them. Eventually every country subscribed to the establishment of the Pasteur Institute.

The long strain and anxiety of the work on hydrophobia had told upon Pasteur's health, and in the winter of 1886 he was persuaded to take a holiday in Bordighera, but in spite of the sunshine and brightness of the climate, he was not happy there. Reports of the inevitable opposition aroused by his discoveries disturbed him, and he longed to return to his laboratory, where he could refute his adversaries by practical demonstration. From Bordighera he went to Arbois and, amid the associations of his early days, his health and spirits revived for a time, and he returned to Paris in July 1887. He was appointed Life-Secretary of the *Académie des Sciences*, but in 1888 another shock of paralysis obliged him to resign

from this post. He rallied once again, however, and spent much of his time inspecting the arrangements for the Pasteur Institute or among the patients in its laboratory, but his health was gradually failing. In 1894 he left Arbois after his holiday for the last time and returned to Paris, to watch from his study window all the coming and going and activity in the new Institute, proud that his disciples and collaborators should have such magnificent facilities for their work which was founded on his own labours in the small laboratory in the Rue d'Ulm.

On the 28th of September 1895 he died peacefully at Villeneuve L'Etang, not far from Paris, where his work on hydrophobia had been chiefly carried out. There is a chapel erected to his memory at the Pasteur Institute, but his enduring memorial is all around us everywhere in the common life of every day; in the preservation of our food, the fertilising of our soils, the sanitation of our cities and in the work of every laboratory and hospital in the world. For his discoveries were the foundation of an unceasing train of researches of incalculable benefit to the human race.

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LORD LISTER, O.M., F.R.S.

1st Baron of Lyme Regis

1827-1912

The great name of Lister is familiar to us all. He has so recently passed from us and, since in his lifetime he enjoyed the fame which too often is only accorded to the great when they are gone beyond its reach, his work must be fresh in our memories. Yet, because it is easy for a generation born to all the benefits science can give, to take their heritage for granted, and to ignore the infinite labours which went to achieve it, we do well to look back sometimes. The word "hospitalism" is not familiar to the present generation, but in Lister's young days it was coined "to signify the morbid conditions arising from the gathering of diseased persons in a hospital," and Sir James Young Simpson, the first surgeon to use chloroform as an anæsthetic, discussing the subject at that time, said: "A man laid on the operating table in one of our surgical hospitals is exposed to more chances of death than the English soldier on the field of Waterloo." Those were the days before the introduction of the antiseptic system, and to Lister we owe it that the whole outlook of surgery was changed.

Joseph Lister's parents were Quakers of Yorkshire origin. His father, Joseph Jackson Lister, was a London merchant by profession, but also a man of

LORD LISTER
1827-1912

From a photograph by Mr R. A. Bickersteth, F.R.C.S.

scientific interests, whose invention of special lenses for the achromatic microscope first made of that instrument a powerful weapon in research. He was a Fellow of the Royal Society, and his work on the microscope, besides proving of inestimable value in his son's researches in after years, directed the boy's attention at a very early age to the minute animal life that the microscope revealed. The Listers lived at Upton in Essex, a place only five miles from London, but in those days quite in the country, and the resort of many Quaker families. Their home, Upton House, an old Queen Anne residence, lay in the midst of a green park with attractive gardens. It is now the Vicarage of St Peter's Church, its once beautiful surroundings immersed in London's industrial dwellings. Here Joseph Lister was born on the 5th of April 1827, the second son of a family of seven. His boyhood was a happy one, his family being much attached to one another and sharing to a great extent the same interests. From his father he learnt to use the microscope and to cut sections. He was sent to the Quaker School of Grove House, Tottenham, where he remained until his seventeenth year, and showed considerable aptitude for Classics and for languages, especially French and German. He was able in later years to make public speeches in both of these languages.

In 1844 he entered University College, London, first taking a course in the Faculty of Arts, though he intended to follow the profession of Medicine. At that time, as now, there were distinguished men in the Medical Faculty of University College, for Sharpey held the Chair of Physiology, Wharton Jones was Professor

of Ophthalmic Medicine and Surgery, and Thomas Graham, who did distinguished work on the colloids, occupied the Chair of Chemistry. Wharton Jones's work on the circulation proved very stimulatiug to Lister. He was the first to describe the rhythmic contractions of the veins in the frog's web and bat's wing, and his researches directed Lister to the study of inflammation. But to Sharpey, the great physiologist, Lister owed most of the inspiration of his College days. Sharpey's lectures awoke in him a love of physiology that remained all his life, and "aided by a first-rate achromatic microscope given him by his father, he worked out the details of histology" to which his attention had been drawn by this great master. During his student days, Lister did some remarkable physiological researches. His first published paper, on the "Muscular Tissue of the Iris," appeared in the *Quarterly Journal of Microscopical Science* for 1853, his second on the "Small Muscles of the Hairs," which had been discovered by Kölliker, showed the attachments of these muscles to the skin, and appeared in the same journal, and the third on the "Involuntary Muscular Fibre," bringing evidence in support of Kölliker's account of this variety of muscle, was published in the *Transactions of the Royal Society of Edinburgh*, in 1857. All of these papers threw some new light on the subjects under observation, and referring to the last research, Professor Engelmann, Professor of Physiology at Utrecht, writing to Lister in 1895, when he hoped to repeat Lister's observations, said: "I fear I shall not come much further than you have already been, nearly forty years ago."

When Robert Liston, the Edinburgh surgeon, did the first operation ever performed under ether in this country in the theatre of University College Hospital, Lister was present. By the introduction of chloroform surgery received a great impetus, and many operations were undertaken which before would have been considered to entail too much risk. But, as the number of operations increased, so in proportion did the number of deaths, for, however skilful the surgeons might be, and the art of surgery had attained a very high level in manipulative skill in the days before chloroform had lessened the necessity for saving time and pain, there stalked through all the hospitals of Europe and America the dread ogre of blood-poisoning. Septicæmia, erysipelas, hospital gangrene, following suppuration of the wound, were the common lot of the patient who had undergone a surgical operation, and the mortality from these was appalling. This fact deeply impressed Lister and greatly distressed him as he walked the wards of University College Hospital and saw how every effort of the surgeon was overshadowed by the grim spectre of death. Thenceforth he resolved to devote all his scientific powers to the solution of this problem.

In 1852 he graduated M.B. of the University of London, and was elected a Fellow of the Royal College of Surgeons, and in 1853 he went, on the advice of Professor Sharpey, to study under the famous surgeon, James Syme, of Edinburgh, intending later to settle in London as a consulting surgeon. The fates, however, decided otherwise, for Syme was not slow to mark a good man, and in 1854, his house-surgeoncy falling vacant, he appointed Lister to fill it. Two years later Lister sealed his connection

with Edinburgh by marrying Syme's eldest daughter, to whose constant and devoted help throughout his life he owed a great deal. She acted as his assistant and amanuensis, and shared with him his love of natural history, the pursuit of which on their holidays was one of their chief recreations. Their honeymoon was spent visiting the Continental hospitals and medical schools, and Lister made the acquaintance of many famous European surgeons. On his return, he was appointed Assistant-Surgeon to the Royal Infirmary of Edinburgh. The wards of the Old Infirmary were in no way exempt from the terrible scourge of septicæmia, and, while his fame as a surgeon and scientific worker grew, he became more and more occupied with the problem of the cause of suppuration in wounds. "He was staggered," as Sir Rickman Godlee, his biographer, says, "at the universal ignorance about the first and most fundamental subject he would have to teach, namely, inflammation." His experiments and observations on inflammation were continued over the next five years. His paper on the "Early Stages of Inflammation" was read before the Royal Society on the 18th of June 1857, and published in the *Philosophical Transactions* for 1858, as was also a remarkable series of observations he made on the "Cutaneous Pigmentary System of the Frog," and his observations on the coagulation of the blood were read before the Medico-Chirurgical Society of Edinburgh in 1859, and finally formed the subject of his Croonian Lecture, delivered in June 1863, before the Royal Society. Lister was confident that decomposition and suppuration were brought about by the air in some unknown way; but he was equally sure that the gases of the

air, which were generally suspected of being the cause of putrefaction in wounds, were not the causative agents.

In 1860, when the Regius Professorship of Surgery in the University of Glasgow became vacant, the Crown appointed Lister to fill the Chair. And here again, in spite of the fact that the wards occupied by the new professor in Glasgow Royal Infirmary were in new buildings, which it had been hoped would be free of all infection, the prevalence of septicæmia was just as great, if not greater, than in Edinburgh. So bad were the conditions, that Lister was obliged to admit that he considered it "a questionable privilege to be connected with the Institution." Public opinion had been attracted to the subject, and so great was the alarm that the question of pulling down the existing hospitals and substituting temporary huts had even been considered. But Lister fought on in pursuit of the enemy, never allowing himself to be disheartened nor losing sight of the goal. He noticed that septicæmia only followed in wounds where the skin was broken: it was unknown in wounds where the skin remained intact. He concluded, therefore, that the cause must be sought not in the blood, nor in the body, but in some outside agency. "Gentlemen," he said to his students in the Glasgow Royal Infirmary, "it is a common observation that when severe injuries are received without the skin being broken, the patients usually recover, and do so without any severe illness. On the other hand, trouble—often of the gravest kind—is always apt to follow, even in the trivial injuries, where a wound of the skin is present. How is this? I cannot help thinking that the man who

is able to explain this problem will be the one who will gain for himself undying fame."

At last the day dawned when Louis Pasteur, the chemist, announced the results of his experiments in fermentation to the French *Académie des Sciences*, and the bubble of Spontaneous Generation, a theory which had been long and hotly debated in scientific circles, was burst. Pasteur showed that fermentation was not the result of chemical action as had been suspected, but of contact with tiny living germs, or micro-organisms, which fill the air around us. Kill these germs in any substance by heating it up to a point at which they cannot live, and it will remain pure and fresh for any length of time, provided the dust in the air is excluded from it. Admit the air again with its living microbes and your material begins to teem with life.

When Joseph Lister heard this news, he saw at once its meaning for surgery. He saw that the germs of the air were the cause of putrefaction in wounds; an outside cause, as he had suspected. It was, however, one thing to recognise the cause of suppuration and quite another to apply the knowledge to a living subject with success. The first experiment he made in March 1865 was unsuccessful. His next case in August of the same year did well, and he went on working to improve his technique. His first care was to disinfect the wound and the skin, for which purpose he used carbolic acid lotion, and then to apply his dressing of carbolised lint. These primitive dressings have long since been superseded, and were much criticised at the time on account of the destructive action on the tissues of the carbolic lotion; but with the knowledge then available, it is difficult to see how

a better method could have been invented, and Lister continued to improve his technique as he gained more experience, and to a large extent did away with many of the objections to the first form of dressing. By 1867 he was able to publish in the *Lancet* an account of eleven compound fractures treated successfully by his antiseptic surgery, and between the years 1867 and 1870 he published seven papers describing the improvements in his methods of treatment. In his wards in Glasgow Infirmary a revolution was in progress: pyæmia, hospital gangrene and erysipelas following operation were vanishing before the onslaught of his antiseptic system. But every man who sets himself to introduce new methods, contrary to accepted opinion, must lay his account with scorn and derision. In spite of the fact that an unceasing warfare had been waged in vain against the spectres of blood-poisoning which for years had haunted surgery; in spite of the failure of the demolition of old buildings and the erection of new ones to reduce the mortality, Lister's successes were greeted with hostile criticism. The theory of spontaneous generation died hard, and the germ theory to most surgeons of Lister's day was almost unbelievable. Few of his colleagues came to his wards to see for themselves the results of his work, and for a long time, incredible though it now seems, the old methods of treatment were carried on in wards alongside his own, and all the old diseases flourished.

In 1869 Syme resigned the Chair of Clinical Surgery in Edinburgh, and Lister was appointed in his place. He was warmly welcomed by enthusiastic students who filled his lecture rooms, but here, as in Glasgow, he encountered much opposition both from those who could not, and from those who would not

believe his new doctrine. But he worked steadily on, improving his technique as more and more complicated operations, such as the surgeons of that day would never have contemplated attempting, were undertaken, and instructing the young men who would eventually carry his system to the ends of the earth. All those who came in contact with him fell under the spell of his rich personality, becoming devoted and enthusiastic disciples. The Sunday afternoon visits to his wards at the Royal Infirmary were one of the most looked-forward-to events of the week. When the time approached, his assembled staff would wait eagerly for the advent of "the Chief." A man of powerful build and very handsome, Lister's charm of manner, his courtesy, his singleness of aim, his humility, and, above all, his benevolent smile made a strong appeal to all, but to his students and to his patients he was little less than a god, the well-beloved master in whose service their greatest joy was found. The enthusiasm he inspired in those who had the privilege of working with him is well described by one of them: "It was made clear to us," he said, "that the whole atmosphere of class-room and of wards was imbued with the spirit of the great cause, to be carried through with enthusiasm." Thus they would follow him round the wards on those Sunday afternoons, when he would visit every patient, dressing with his own hands the severe cases, explaining with infinite patience every difficulty, showing them how what was "æsthetically impure" could be made by antiseptics "surgically pure," until a full four hours would have passed as if by magic.

His occupancy of the Chair of Clinical Surgery in Edinburgh was perhaps the most brilliant period of

Lister's career. In the face of the revolution he accomplished in the surgical wards of the Royal Infirmary, the opposition to his methods could not long be maintained, and his fame spread till it was well established throughout Scotland and abroad. When the British Medical Association met in Edinburgh in 1875, four or five hundred members of the medical profession, physicians and surgeons, filled the large theatre in the old Royal Infirmary to hear and to see Lister's demonstrations of antiseptic surgery. Having addressed his audience, his first patient was brought in, and he performed the operation before the eyes of the believers and the incredulous alike. That audience left the theatre having seen such things as they had never before witnessed. Lister's Address to the British Medical Association on this occasion was published in the *Edinburgh Medical Journal*, vol. xxi., 1875-76.

In 1877 Lister was invited to fill the Chair of Clinical Surgery at King's College in London. This invitation he readily accepted, being anxious to introduce his antiseptic system to the metropolis, where as yet it had made no impression. He took with him his house-surgeon, Sir Watson Cheyne, and his assistant, John Stewart. On his arrival at King's College, his classes were sparsely attended and his wards were by no means full. The disappointment this entailed must have been bitter. His fame on the Continent, where his antiseptic system had been adopted, was by this time widespread. Foreign surgeons had come to Edinburgh to see his work and learn his technique. When he toured the European hospitals in 1875, the *Lancet* reported, that "The progress of Professor Lister has assumed

the character of a triumphal march." Again, at the International Medical Congress at Amsterdam in 1879, the *British Medical Journal* said: "He was received with an enthusiasm which knew no bounds." Yet London, his *alma mater*, remained sceptical. With all the courage which faith in his cause inspired, Lister addressed himself once more to the task of converting the unbelievers. His inaugural lecture at King's College, to an audience composed not only of students but of many distinguished doctors and scientists, was a war-like gesture, for he chose for his subject "something which should have interest and, if possible, even instruction, not only for the student but also for the eminent men whom he had the honour to see around him," the *Nature of Fermentation.* So he entered the lists immediately, and by degrees his great ability as a teacher made itself felt, his fame as an operator grew, and the success which followed the adoption of his antiseptic methods in hospital could no more be ignored in the metropolis than it could in Edinburgh. London, the last "stronghold of the opposition" had to fall into line, and accept nothing less than the revolution in surgery Lister's genius had made.

In 1880 honours began to come to him. He received the honorary degrees of Oxford and Cambridge and of many foreign universities. In 1883 a baronetcy was conferred upon him, and in 1892, after fifteen years at King's College, he resigned the Chair of Clinical Surgery owing to the age limit. He was appointed Foreign Secretary to the Royal Society, and held this post till 1895 when he was elected President, an office which he occupied till 1900. In 1897 he was raised to the peerage and took the

title of Baron Lister of Lyme Regis, and in 1902 he received the Order of Merit, being one of the first recipients of this new order.

In 1903, when he was seventy-six years of age, Lister had a serious illness when he was at Buxton, which left him an invalid for the remainder of his life. Up till then his health had been good for one of his years, allowing him to take an active part in all public affairs, though the death of Lady Lister in 1893 had been a severe blow to him. He now left London for Walmer, and lived in great retirement for his remaining years, and there he died on the 10th of February 1912, at the great age of eighty-four, crowned with every honour a grateful nation could bestow. A public funeral service was held in Westminster Abbey, where a medallion portrait of him was afterwards placed among a group of eminent scientists of his time. He was buried by his own wish in West Hampstead Cemetery beside his wife. He left no heirs, but bequeathed many gifts of surgical interest to Edinburgh University, with all his medals from learned societies, including the documents of the Freedom of the Cities of London and Edinburgh, in token of his regard for the Edinburgh School of Medicine, where his devoted service in the cause of humanity began.

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SURGEON-MAJOR TIMOTHY RICHARDS LEWIS, M.D.

1841-1886

One of the most distinguished names on the roll of the Army Medical School is that of Timothy Richards Lewis. His original contributions to medical science, his patient, painstaking investigations into the world of the infinitely small, and his expert use of the microscope, combined with his earnest work as a teacher of research, had just earned him a high place as a pioneer in the history of tropical medicine, when death cut short his promising career at the early age of forty-four.

Timothy Lewis was born at Hafod in the parish of Llangan East, Carmarthenshire, on the 31st of October 1841. He was the eldest of the eight children of William and Britannia Lewis, both of whom came of well-to-do farming stock whose ancestors had farmed the land for at least three generations. His father carried on the family tradition with success at Crinow Farm, Narberth, in Pembrokeshire, a few miles distant from Hafod in the next county, and here Timothy was brought up. His mother, before her marriage a Miss Richards of Hafod, was a woman of much charm and a great favourite in the neighbourhood. Timothy attended the National School, the only school in the town, until he was nine years of age, when a new Grammar

Timothy Richards Lewis
1841-1886

School was opened by the Reverend William Morris and he became one of the first pupils. The school was small but efficient; Timothy was a hard worker and formed a lasting friendship with the headmaster. At the age of fifteen, he was apprenticed to an apothecary in the town, and at nineteen obtained a position in London with a Mr Porter, a chemist of Streatham. From here he went as compounder and dispenser of medicine to the German Hospital at Dalston, a post which he obtained through a former schoolmate who had just vacated it, and here he acquired that useful accomplishment for a scientific life, a knowledge of the German language and, while still at the hospital, attended lectures at University College, winning the "Fellowes" silver medal for clinical medicine in 1866. He did not, however, take his degree in London, but went to Aberdeen University and qualified there in medicine and surgery in 1867, graduating "with honourable distinction." In 1868 he passed first in order of merit into the Army Medical School at Netley, and, at the end of four months, headed the list of those who passed out, distinguishing himself particularly in pathology, medicine and hygiene. He received his commission as Assistant-Surgeon on the 31st of March 1868.

At the time when Lewis left the Army Medical School, the problem of how to combat the onsets of Asiatic cholera, of which there had been three severe epidemics since 1831, was occupying the attention of those in authority. This disease, comparatively new to Europe, brought in its train, by reason of its sudden onset and grave consequences, something of the terror inspired by former epidemics of the plague; and after one or two experiences of

it public alarm was naturally easily aroused. Nothing was then definitely known of the manner of communication of cholera, although Dr Snow had published his paper *On the Mode of Communication of Cholera* in 1849, with an account of his theory of the propagation of this disease by means of the intestinal discharges and the part played by the sewerage of London in its dissemination; and by 1855, an enlarged edition with additional evidence in support of these theories had appeared. In Germany the theory of the fungoid origin of cholera, propounded by Professors Hallier of Jena and de Bary of Strasbourg, was attracting much attention, the idea being that the "poison" of the disease developed in a fungus which attacks rye in England and the rice-plant in India, and reached man through the food consumed. Still another theory had obtained some support from the researches of Professor von Pettenkofer, the celebrated Health Officer of Munich, who held that the soil, when it contained sufficient moisture, was the breeding-place of the cholera germ, or "poison," and that it lay dormant in the dry season awaiting the return of suitable conditions for its activity. The whole subject was very complicated, and the English Government decided to send two Army Medical surgeons to study the question in Germany and thereafter to make extensive investigations in India. For this purpose the two officers who had obtained the highest marks in the examination at Netley were chosen, Lewis from the Royal Army Medical Corps and D. D. Cunningham from the Indian Medical Service. Thus, at the very outset of his career, Lewis had the golden opportunity of devoting his talents to research. With Cunningham

he went to Germany and studied for three months in the laboratories of Hallier and de Bary, and afterwards with Pettenkofer, with whom he made great friends, at Munich.

In January 1869, he and Cunningham reached Calcutta, and were attached for special duty to the Sanitary Commission of the Government of India. Their instructions were to investigate the cause of cholera, especially in the light of Hallier's and Pettenkofer's theories with regard to its origin, and for ten years Lewis was occupied with this inquiry. After the severe epidemic of 1869, he visited the places in the North-West Provinces which had been the centre of the epidemic, among them Allahabad, Cawnpore, Lucknow, Agra and Fyzabad, making tests of the soil and the water in each locality, in addition to the investigations carried out on cholera patients. As a result of his first year's work, he published in 1870 a report "On Microscopic Objects in Cholera Discharges," which appeared as an Appendix to the *Sixth Annual Report of the Sanitary Commissioner with the Government of India*, and contained the first account ever given of the amœbæ found in the intestine. Lewis found no evidence in support of Hallier's theory of the fungoid origin of cholera, nor yet any evidence to confirm Pettenkofer's theory of the soil as the breeding ground of the disease; but he admitted that this last matter was by no means so simple that "he who runs may read," and that his researches had not gone very far. Two supplementary reports with D. D. Cunningham followed this in 1872 and 1874, entitled *Microscopical and Physiological Researches into the Nature of the Agent or Agents producing Cholera.*

In the intervals of his work on cholera, Lewis carried out many other important investigations, among them that which led to his famous discovery of the causative agent in the obscure disease of chyluria, the *Filaria sanguinis hominis*. While examining a specimen of urine obtained from a patient suffering from this disease in March 1870, he saw some microscopic worms. How easily these worms might have escaped detection of even such an expert in the use of the microscope as Lewis, may be judged from the description he gives of them in his report: "When first seen, I thought they were some detached filaments of fungus, judging from the structureless appearance presented; after a time, however, a few of them were observed to move slowly, when all doubt as to their nature was at an end. It will not be surprising that the existence of these worms was not suspected, when we consider that fully two hundred of the larger size . . . could pass abreast through a small pinhole, an orifice not exceeding the fiftieth of an inch in diameter, as may be verified by a simple calculation." A specimen of the worms was sent to Dr Parkes at Netley and they were identified as belonging to the *Filaridæ*. The report of this discovery was published with his report on cholera, and an abstract of it appeared in the *British Medical Journal* of 19th November 1870.

Lewis had intended to follow up the original case in which the worms were first seen, with further periodical examinations, but the patient was discharged unexpectedly from the hospital and left no address behind him, and although extensive inquiries were made through the native bazaar for this man, he could not be traced, as anyone familiar with

the conditions under which the natives live in India can readily imagine. In July 1872, whilst examining the blood of a native under the microscope at the Medical College Hospital in Calcutta, Lewis saw nine minute worms in a state of great activity and was able to identify them with those he had seen and described two years before in the urine of the patient who had disappeared. Up till this time these worms had not been known to exist in the blood, nor had their minute anatomy been described. In the intervening two and half years unremitting search had been made for the parent worms (for what Lewis had seen were embryos), and some investigators thought they had discovered them in the heart of the dog, but after many experiments Lewis proved these to be of a different genus. The account of this discovery was being printed in the Government Printing Establishment in Calcutta, when the author happened to look into the office, and there, to his utter surprise, he saw in front of him, putting his notes into type, the very man for whom such diligent search had been made. Although he was transcribing an account of his own case, "being rather below the average intelligence," said Lewis, "he had not the remotest idea to what the manuscript referred." But in the afternoon of the same day, whilst Lewis was preparing seven slides for the examination of this native's blood, the man reminded him that two and a half years before he had only prepared one slide, a circumstance which the doctor had quite forgotten. "This little incident," said Lewis in his report, "conveys its lesson; had I taken a dozen slides on the first occasion instead of one, the date of the detection of the *filaria* in the blood would probably

have been simultaneous with their detection in the urine."

From the time that these worms were found in the blood they were named *Filaria sanguinis hominis*, and it was an account of this discovery that Manson read of in the British Museum in 1875, when on returning from China he searched London for information on tropical diseases, and especially on chyluria. And it was the life-history of this parasite that Manson traced within the body of the mosquito, thereby greatly facilitating later researches on the means by which malaria is transmitted from man to man. Lewis's report on this discovery, "A Hæmatozoon in Human Blood: its Relation to Chyluria and other Diseases," was published in the *Eighth Annual Report of the Sanitary Commissioner of the Government of India*, 1872, and in the *Indian Annals of Medical Science* of January 1874, and, finally, in *Quain's Dictionary of Medicine*, Lewis gave a masterly account of all that was then known of the disease of *Chyluria*. Shortly after the publication of the article in *Quain's Dictionary* under the title *Chyluria*, he had the good fortune to find the mature form of the worm in a patient suffering from elephantiasis. After a continuous search of eight hours in some of the matter taken from the tumour of the patient, the long-sought-for parent was eventually found. This discovery was made on the 7th of August 1877, and, independently of Lewis's work, Dr Bancroft of Brisbane in Australia had discovered the mature worm on two separate occasions, a notice of which was published in the *Lancet* of the 14th July 1877, by Dr Cobbold, the naturalist. Lewis's description of the parent worm was published both in India and in London before Dr Cobbold had

even seen the Australian parasites, which were forwarded to him for description; but Bancroft's discovery was actually made before Lewis's and therefore the adult worm was named *Filaria Bancrofti.*

In 1874, *The Pathological Significance of Nematode Hæmatozoa* was published. In these reports Lewis gave minute detailed descriptions and measurements of the tiny worms, illustrating his papers with numerous plates. Sometimes he would spend as much as five hours or more looking through the microscope before he found the worm and, as a caution to students expecting to find them casually, he said: "It must not be supposed that the *Filaria sanguinis hominis* are to be detected by taking a mere peep through the microscope. Anyone who imagines that they can be detected with the same ease as a white blood corpuscle had better not make the attempt." But, although the search was arduous, the result for Lewis amply repaid the labour. "The appearance presented by the *Hæmatozoon,*" he said, "when first seen among the blood corpuscles, in the living state, will not readily be forgotten, and cannot possibly be mistaken for anything else. The remark made by a young Bengalee student on my requesting him to look into the microscope and tell me what he saw—'He is an incompletely developed snake, evidently very young, though very active'—so aptly describes the object as thus witnessed, that I feel sure that anyone seeing the *Hæmatozoon* alive will not fail to be struck with the accuracy of the quaint reply."

Lewis published *The Soil in its Relation to Disease* along with D. D. Cunningham in 1875. It contained an account of observations carried out to determine to

what extent peculiar conditions in the soil of Calcutta affected the prevalence of disease. The inquiry involved many investigations into the fluctuation of subsoil water; Pettenkofer wells for measuring the water were sunk, and it was at the special suggestion of the Bavarian Health Officer that many of the observations were made as to soil temperature, and the amount of carbonic acid in the soil as compared with Munich. In 1877, Lewis was elected a Fellow of the University of Calcutta, and in this year he published, again with D. D. Cunningham, a report on *Leprosy in India*, a disease of which they had made a study since 1873, and a paper on *The Oriental Sore.* 1878 saw the publication of an important monograph on "Microscopic Organisms found in the Blood of Man and Animals" in an Appendix to the *Fourteenth Annual Report of the Sanitary Commissioner.* It contained an account of Lewis's discovery in the blood of a rat of a *trypanosome*, the genus of parasite which is the causative agent in sleeping sickness. This was the first description ever given of a trypanosome found in a mammal, and it was named after the discoverer, *Trypanosome lewisei.* Although this, the first mammalian trypanosome, was discovered in 1878, it was not till many years later that the connection of trypanosome infection with human sleeping sickness and the mode of the transmission of *Trypanosome gambiense*, another species of this class of organism, by the tsetse-fly were definitely proved. In the same year, 1878, Lewis published another paper with D. D. Cunningham on *Cholera in Relation to Certain Physical Phenomena*, recording the seasonal fluctuation of the disease in Calcutta and among the troops. And at the end of

this year he took fifteen months' leave, spending six months of his time visiting the laboratories of Europe, in Berlin, Dresden, Prague, Vienna, Strasbourg and Munich, where he met his old friend Professor von Pettenkofer, Virchow, and many other distinguished scientists.

Lewis's marriage to Miss Emily Brown of Lewisham took place on the 8th of October 1879, and immediately after this he returned to India. He was attached to the secretarial staff of the Surgeon-General, and went with him to Simla in the hot weather. In 1881 he published a *Memorandum on the Dietaries of Labouring Prisoners in Indian Jails*, a comprehensive work, surveying the amount and kind of food required in the performance of muscular work, in the light of the then new theory, that sugar-producing foods were the basis of muscular work as opposed to Liebig's theory of a nitrogenous basis, a subject which Parkes had chosen for his Croonian Lecture of 1872. In 1882, after investigating the cholera outbreak among the Somalis at Aden, he published a report on this subject, and this was the last of his work in the East, for in 1883 he was offered the post of Assistant Professor of Pathology, under his old teacher, Professor Aitken, at Netley, and in March of that year he returned to England and took up his work at the Army Medical School. The methods of practical instruction in bacteriology which Lewis's pioneer work in India had evolved, were now introduced at Netley for the first time. The science was then in its infancy, but Lewis could scarcely be excelled in his expert use of the miscroscope and he had the processes of staining and counter-staining at his finger-ends. It was in a great measure due to

him that the foundations of research work at the Army Medical School were so securely laid.

Lewis represented the Government of India at the International Sanitary Conference at Amsterdam in 1883, and again at Rome in 1885, and it was due to his protest, because of their inefficacy, that the strict regulations for quarantine against cholera were somewhat modified. Meanwhile in 1884 he had been to Marseilles to investigate the cholera outbreak there, in the light of Koch's alleged discovery of the cause of cholera in the comma-bacillus. As a result of this inquiry, the report of which was published in the *Lancet* of 20th September 1884, he claimed that a curved or comma-like bacillus, identical in size, form, and in its reaction to aniline dyes with those found in cholera, is ordinarily present to a greater or less extent in the secretions of the mouths of perfectly healthy people, whereas Koch and many other distinguished investigators had announced their inability to find the comma-bacillus except in cases of cholera. Lewis was subsequently secretary to a committee convened by the Secretary of State for India to report on Koch's discovery under the Chairmanship of Sir William Jenner, and this report, drawn up by him, was signed by every member of the committee. Subsequent experiments confirmed Koch's discovery of the comma-shaped bacillus as the causative agent in cholera, but it was not till 1894 that this was generally accepted by the medical profession.

In the spring of 1886 Lewis developed pneumonia, as a result, it was said, of accidentally inoculating himself with some micro-organisms while engaged in an experiment in the Army Medical School. To the great loss of the scientific world and the deep regret

of his colleagues, he died on the 7th of May, and was buried in the Royal Victoria Hospital Cemetery at Netley. He had not reached his forty-fifth year, yet the record of his work is a formidable one, and especially so when it is remembered that it was done before the great advance in scientific knowledge of recent times. Shortly before his death, he had been recommended by the Council of the Royal Society for election as a Fellow, and had he lived but a few weeks longer, he would have received this great distinction.

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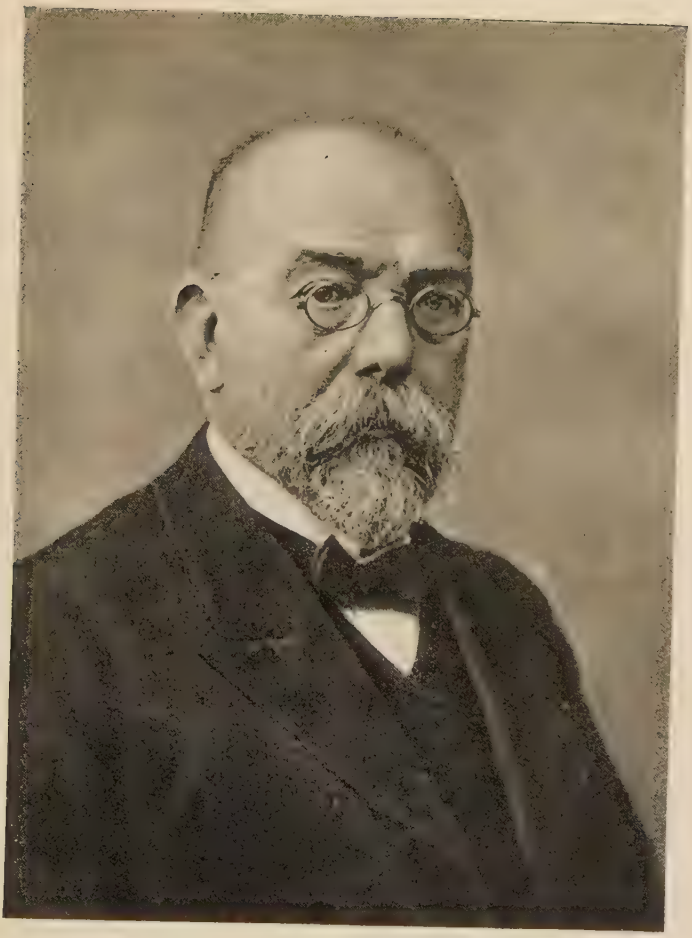
ROBERT KOCH, M.D., F.R.S.

1843-1910

After Pasteur and Lister, as if to set the seal upon their work by providing, as Sir Charles Martin, the Director of the Lister Institute, has so aptly said, "the tools of inquiry at each stage in the development of bacteriology," came Robert Koch. Although the list of his brilliant bacteriological achievements is a long one, his name is chiefly associated in the public mind with the discovery of the tubercle bacillus, and the identification of this germ was of vast importance to the welfare of mankind as being the starting-point for a world-wide campaign against one of the most deadly enemies of the human race. But as the founder of modern methods of bacteriology, Koch prepared the way for a new direction in the science of hygiene, and the last quarter of the nineteenth century saw the advance of sanitary science, not by slow and painful efforts as in the century's beginning, but by vast strides forward which left far behind them the accumulated knowledge of the ages. Pasteur had led the way by the discovery of the germ theory; Lister, with the insight of genius, had been quick to grasp its application for surgery, saving millions of lives by the introduction of antiseptic methods; but even so, when Koch began his medical career, the science of bacteriology was still in its infancy, and its technique quite undeveloped. Koch's arrival



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at this juncture was fortunate for the world, for, as Sir Charles Martin has said, "to devise successful means to attack a problem involves a clear insight into the nature of the problem, and fertility of resource in overcoming the technical difficulties arising in every experimental inquiry. With both these qualities Koch was richly endowed. He defined clearly the exact point at which knowledge had already arrived, and not only saw what was the next question to ask of Nature in order to advance one step farther, but devised experimental methods which ensured an answer to his question. In this last faculty Koch was pre-eminent, and the methods of the sciences are to a large extent the methods of Robert Koch."

One of the thirteen children of an official in the Prussian Forestry Department, Robert Koch was born on the 11th of December 1843, at Klausthal in Hanover. He studied medicine at Göttingen from 1862 to 1866, and held an appointment as assistant in the General Hospital at Hamburg for a short time before setting up as a general practitioner first at Langenhagen, near Hanover, and afterwards at Rackwitz. In 1872 he was appointed Medical Officer of Wollstein, a small town in Polish Prussia, and here, far removed from all laboratories and facilities for research, with little more than a good microscope to aid him, and the cares of a private practice to claim his attention, he began his studies in bacteriology. Four years had not gone by before he published the results of his first research, one which was to bring his name into prominence in the scientific world, that on the etiology of anthrax.

In 1839 the bacillus of anthrax had been seen in the blood of infected animals; but its significance had not

been grasped, and in 1863, when Pasteur's researches were becoming known, Davaine had been able to prove that this bacillus was capable of infecting animals inoculated with it, but that the germ was the true cause of anthrax was disputed. Koch, therefore, set out to prove that the anthrax bacilli were the only cause of the disease. Up till then although numerous bacilli had been identified in various diseases, it had not been proved beyond dispute that a given bacillus was the cause of a given disease, and the difficulty of isolating one bacillus from other germs in the blood had not been overcome. Koch's first contribution to the science of bacteriology lay in his success in overcoming these difficulties. He cultivated the germs of anthrax outside the animal body in broth and succeeded in developing many generations of them, isolating them from all other germs in the blood, thereby obtaining a pure culture. By inoculating mice and rabbits with this culture, he produced in them the disease of anthrax, and for the first time there was conclusive proof that a particular bacillus was the cause of a particular disease. His paper on the life-history of the *Bacillus anthracis*, containing the account of these experiments, was published in 1876, and in the same year he published a valuable paper describing the use of the microscope and his methods in staining and photographing bacteria, for he was convinced that better results would only be attained when the investigator had at his disposal better tools and methods of work.

After the anthrax research, Koch went on to the study of infective diseases caused by wounds, to which his attention had been drawn by the disasters from septic wounds in the Franco-Prussian War, and possibly

by Lister's success in the use of antiseptic surgery. Here again, his aim in investigating the infectious diseases of wounds was to isolate the particular organism that caused the septic condition. Bacteria had frequently been found in erysipelas, in pyæmia and other diseases, but as in anthrax, the proof was wanting that any particular germ caused the disease and no other. Koch's research was carried out by inoculating animals with a putrid serum or broth, which contained numerous bacilli of all descriptions. And his anticipation that from this medley of germs, which he was himself unable to separate, the animal's blood would pick out for cultivation the germ which suited it, and leave the rest, proved to be correct. After small quantities of the putrid broth containing the various germs had been injected and the animal had developed symptoms of the disease, its blood was examined microscopically, and in it there was found one, and one only, of the many germs with which it had been inoculated. The disease, too, could be given to a second animal by inoculating it with the blood of the first. The animal body was then seen to be a most effective mechanism for obtaining a pure culture. Koch proved also the now well-established fact, that some species of animals are proof against, and will not develop, certain parasites, or microbes, as was seen later when the cholera microbe was discovered, and it was found impossible to produce this disease in any animal. The paper in which these researches are described was published in 1878, under the title, *Untersuchungen über die Ætiologie der Wundenfektions-krankheiten*, and was translated into English by Sir Watson Cheyne, on Lord Lister's suggestion, for the New Sydenham Society, in 1880,

entitled *Investigations into the Etiology of Traumatic Infective Diseases.*

The publication of these important papers at once attracted the attention of the scientific world, and Koch was appointed a member of the State Public Health Department in Berlin, the Director of which had not failed to notice that the author of these works was possessed of exceptional ability. There was at that time no department of bacteriology in the Health Office, and Koch fitted up with all his apparatus the one room which was allotted to him as a laboratory, and here he was joined by his two assistants, Loeffler and Gaffky, whose distinguished work was subsequently to leave its mark in the history of medicine. These three, working together, directed their energies to the improvement of the technique for obtaining germs in pure culture outside the animal body, and Koch soon evolved his famous solid culture medium. The account of this work was published in the first volume of the reports of the State Public Health Department in 1880, and the paper was translated for the New Sydenham Society by Sir Victor Horsley. It contained a full account of the rules and methods to be followed in the study of bacteriology, and became the standard for bacteriological work in all countries. Koch laid stress upon the importance of giving photographic pictures of micro-organisms, on the absolute necessity of obtaining pure cultures of bacteria if the knowledge of these organisms was to be advanced, and gave a detailed description of the methods he employed for obtaining these cultures. His introduction of the solid culture medium, such as gelatine, was a great advance on former methods of growing cultures. He described how this had been

suggested to him by observing that a boiled potato cut in half and exposed to the air for a few hours and then placed in a damp room to avoid drying, would produce upon its cut surface small droplets or colonies each of which differed from the other. It occurred to him to spread the contents of one of these droplets upon the surface of another potato, and by placing this in a damp room, he found that the bacteria contained in the droplet grew and produced his pure culture. Speaking of this solid nutrient medium for cultures introduced by Koch, a colleague, writing in the *British Medical Journal* of 4th June 1910, says: "There can be no doubt that the introduction of this method of making cultivations on solid media constituted the greatest advance in bacteriological technique which has ever been made, and enormously advanced the science by giving to it a degree of accuracy which it had not previously possessed."

Koch next turned his attention to the research for which his name is justly famous, the identification of the tubercle bacillus. For generations consumption had been regarded as a congenital disease and hopeless because undiscoverable until its advanced stage was reached; and this was in some measure still the popular view of it, when Koch's discovery was made, although its infective nature had been recognised by Klencke as early as 1843, when he infected one animal with the disease from another, and by Villemin in 1865-68. Cohnheim had shown that it was capable of being communicated inside the body, and his pamphlet entitled *Tuberculosis as an Infectious Disease*, published in 1880, was the first attempt to popularise the idea of the infectious nature of the complaint. But, until the bacillus was isolated and its habits

known, no great advance could be made in the measures adopted to prevent its spread. For a long time Koch examined specimens of miliary tubercle under the microscope, in the hopes of finding the microbe, but without success till, by a modification in his methods of staining, the bacillus was at last found; and although difficulties were at first experienced in isolating it, they were eventually overcome when the right culture medium for its growth was found. At the International Medical Congress in London in 1881, Koch showed the tubercle bacillus to some privileged members and, on the 24th of March 1882, at the Physiological Society in Berlin, he made public his discovery. In announcing it he said: "Henceforth, in our warfare against this fearful scourge of our race, we have to reckon not with a nameless something, but with a definite inmate of the body: its conditions of existence are for the most part already known and can be further studied. Before all things, we must shut off the sources whence the infective material comes, so far as it lies in the power of man to do this." The news soon spread through the laboratories of the world and was greeted by some scientists with enthusiasm, by others, who still clung to the hereditary nature of the disease, with incredulity and adverse criticism. Koch himself set to work to study the life-history of the bacillus and to evolve the best methods of combating the disease. Then the bugbear of cholera threatened Europe from the East, and the German Government hastily appointed a Commission with Koch as President, to visit Egypt and investigate the disease, and to lay plans for the prevention of its spread. It was not, therefore, till 1884 that Koch was able to publish his paper on "The Etiology of

Tuberculosis," in the second volume of the *State Public Health Department Reports.* This essay contained a description of the whole process of infection by the bacillus, and all the scientific facts necessary for the guidance of health officers in the campaign against the disease. He showed that the bacillus is not inherited, that it invariably enters the animal body from without, that it grows under conditions of heat and moisture, but is not killed by freezing, though direct sunlight will kill it in a few minutes, and darkness and stagnant air on the contrary will favour its growth.

The repercussions of this discovery led to a campaign against the disease in every civilised state. Congresses on tuberculosis were held in the years which followed, and methods of prevention were gradually brought to a high state of perfection. Koch's disciple, Dr George Cornet, carried out a series of experiments to demonstrate the truth of all Koch had proclaimed, the results of which he published in the *Zeitschrift für Hygiene* of November 1888 and April 1889, entitled "The Distribution of Tubercle Bacilli outside the Body," and "On the Mortality among Nurses and its Causes." The popular instructions against the disease contained in these two papers were adopted by the health authorities all over the world, and when Cornet addressed the Berlin Medical Society in 1895, he was able to prove that a great reduction in the mortality from tuberculosis had followed the adoption of the precautions advocated.

In 1883 Koch's services to science were recognised by the German Government by his appointment as a Privy Councillor, and in the same year, as has been

said, he visited Egypt and India with the German Cholera Commission. When the Commission arrived in Egypt the epidemic of cholera was nearing its end, but it had not quite died out before Koch found strong evidence that the comma-shaped bacillus, so named from its resemblance to the punctuation mark, was the causative agent in the disease. To verify his conclusions, the Commission went on to India, where cholera was then endemic, and Koch satisfied himself that the comma-bacillus fulfilled the four conditions, known as Koch's postulates, those strict rules which he had himself propounded for the identification of micro-organisms. It could always be found microscopically in the bodies of animals having the disease; and in that disease and no other; it could be propagated in pure culture outside the animal body; the inoculation of the pure culture produced the same disease in a susceptible animal; and the organism could be found in that animal.

The discovery, however, was not unanimously accepted until after the Hamburg epidemic of cholera in 1894. Haffkine, a celebrated bacteriologist who did much work on this disease in India, has said that "the cholera microbe is one of those in which, owing to its organisation and mode of life, variability is particularly marked; so much so that not unfrequently, after an examination with all available tests, it is impossible to say whether the germ dealt with is, or is not, a representative of the cholera species." It was little wonder then, seeing that the world-wide researches carried on for years had all ended in unsuccessful attempts to identify this microbe, that Koch's discovery was received with some scepticism.

Before leaving Egypt, Koch had made two other discoveries of importance—that of the amœbæ of dysentery, and of the bacillus which is the cause of the widespread disease of ophthalmia among natives.

In 1885 he left the State Public Health Department and was appointed Professor of Hygiene in the Medical Faculty of the University of Berlin and Director of the new Hygienic Institute which had just been established by the University. He now returned to the study of the tubercle bacillus and endeavoured to find a remedy for the disease. In November 1890 great excitement was caused by his announcement that he had prepared from cultivations of the bacillus a remedy for tuberculosis of the lungs in its early stages, and that experiments had shown that guinea-pigs could be immunised against the tubercle bacillus by repeated doses of this culture, which was later named tuberculin. Doctors flocked to Berlin from all parts of the world to see Koch's results at first hand. He claimed for his discovery not only that it might be expected to cure phthisis in its early stages, but that it might be used as a means of diagnosing the disease. The enthusiasm that is naturally awakened by a new discovery probably led the world to exaggerate the claims that Koch had made for tuberculin. It was administered to patients in what was, in the light of later knowledge, enormous doses, and the results on the whole were disappointing and often fatal, and exposed the discoverer of tuberculin to a good deal of unmerited abuse. The remedy fell into discredit. But tuberculin has since been used extensively in some of its forms as a diagnostic both for man and for agricultural purposes, and Koch rightly claimed the importance

of his discovery. The mistake he made was in underestimating the virulence of the remedy, and in the premature publication of it.

In 1891 Koch was appointed Director of the new Royal Institute for Infectious Diseases, now commonly called the Koch Institute, and in the following eight years a large part of his time was spent in travelling in tropical climates to study tropical diseases. He was engaged on experiments with the mosquito as the means of transmission of malaria when Ross's great discovery of the part this insect plays in infecting man was proclaimed, but the work which Koch did in showing that the three types of malaria are associated with three types of parasites proved of much value in the preventive treatment of this disease. His researches in malaria took him to New Guinea to study a particularly severe type of the disease, and it was here he published a statement that quinine might be a contributing cause of black-water fever which, being misunderstood, for a time prevented the use of that drug in the German colonies in case it should prove to be the only cause of that much dreaded scourge, a conclusion which was far from Koch's meaning. He himself advocated the use of quinine for the prevention of malaria.

In 1896 he went to Cape Colony at the request of the South African Government to study the rinderpest which was threatening to destroy the cattle in South Africa, and in 1897 he returned to India to investigate the plague. The first Plague Commission, appointed at the request of the Indian Government, began its work in 1898. The germ of plague, *Bacillus pestis*, had been discovered by Kitasato and Yersin in Hong-Kong in 1894; but the means of transmission of the

disease was still obscure, and it was not till the Commission had done its work that the flea was definitely proved to be the culprit in the spread of this disease (a disease of rats) from rat to man. From Bombay Koch returned to Africa and made a study of East African fever among cattle. "It would be difficult to adjudge just how much of the knowledge gained upon these diseases to attribute to Koch," says Sir Charles Martin, speaking of Koch's studies in tropical diseases, "as the problems were also under investigation by numbers of other observers, and, moreover, he was usually accompanied by one or more distinguished workers . . . it is very clear, however, . . . that his insight into the nature of infectious diseases and his unrivalled experience were never directed to any of these inquiries without materially enhancing our knowledge of the causation and of the means by which each disease was spread."

In 1901 Koch astonished the world by announcing to the British Congress on Tuberculosis which met in London that the result of experiments had brought him to the conclusion that human tuberculosis was of a different character from the bovine variety of that disease, and that man is little if at all susceptible to the bovine bacillus. Such a statement, coming from the chief authority on the subject, caused widespread consternation, for almost every civilised Government in the world was by this time committed to large expenditure in preventing the infection by milk and meat supplies, and the publication of the news caused the Health authorities in Europe and America to institute inquiries as to whether tuberculosis of bovine animals is communicable to man or not, lest their efforts for the prevention of the disease should be

misdirected. The Second Royal Commission on Tuberculosis, appointed by the English Government, after exhaustive inquiries, reported that bacilli of the bovine form of the disease are often found in human beings, and this evidence was generally accepted as conclusive.

In his later years Koch ceased to take quite such an active part in official life in Berlin as he had done in former times, but his researches in tropical medicine were carried on, often involving long visits to unhealthy climates, right up to the end of his life. From 1903, at an age when most men are glad of some respite from the strenuous work of life, until 1906 he was engaged in studying sleeping sickness in Africa and, that he might the better study the habits of the tsetse-fly which transmits this disease, he settled down in a camp in one of the Sesse Islands. It was well said of him that "scientific work, fearless, keen, close and unremitting, was his greatest happiness, the very breath of his nostrils," until life was done. He died unexpectedly at Baden-Baden on the 27th of May 1910, after an attack of influenza which had weakened his heart, at the comparatively early age of sixty-seven.

Koch was one of the great discoverers of medicine, but he was also a practical contributor to the health and comfort of the human race. It has been said of him: "It was characteristic of Koch's attitude towards scientific problems that he was not satisfied merely to establish laboratory facts—he was always ready to go on to investigate the conditions under which they could be applied to practical hygiene, a task commonly far more difficult than the repetition of experiments in a laboratory, and often raising side-issues which

demand the highest scientific acumen for their elucidation." Born at a time when vast new fields of research were spreading new light all around, he lived to see the science to which he had so largely contributed grow from slender beginnings till it filled an all-important place in medicine, its influence reaching to the ends of the earth. "In a dozen years," says Sir Charles Martin, "the etiological factor of eleven important human diseases—tubercle, cholera, typhoid, diphtheria, erysipelas, tetanus, glanders, pneumonia, epidemic meningitis, influenza, and plague, as well as numerous animal diseases—was discovered by Koch and his pupils." Surely an amazing record for scarcely more than one decennium. Koch himself attributed his success with characteristic humility, to the luck that came his way. Speaking at a dinner given in his honour by the German Medical Society in New York in April 1908, two years before his death, he said: "I have done nothing else than what you are doing every day. I have worked as hard as I could and have fulfilled my duty and obligation. If the success really was greater than is usually the case, the reason for it is to be found in the circumstance that I came in my wanderings through the medical field upon regions where the gold was still lying by the wayside. Fortune is necessary to be able to distinguish gold from the base metals, but that is no great merit."

Koch received many honours from scientific societies during his lifetime, and the German Emperor conferred upon him the *Ordre pour le Mérite*. He was elected a foreign Fellow of the Royal Society, and an Honorary member of the British Medical Association.

He was cremated in Baden-Baden on the 30th of May 1910, and his ashes were buried by his own wish as quietly as possible, only his widow and his most intimate friend Gaffky, besides a few others being present. But if the ceremony was simple, as became a man of science, a whole nation mourned his loss, for his name was a household word in Germany, and one of which his countrymen were justly proud, while the admiration and affection he inspired in his pupils knew no bounds. And outside Germany, seeing that science has no nationality, the world at large paid fitting homage to the passing of one of its greatest sons.

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Sir PATRICK MANSON
1844-1922

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SIR PATRICK MANSON, G.C.M.G., M.B., F.R.S.

1844-1922

In the Parish of Oldmeldrum, Aberdeenshire, Patrick Manson was born on the 3rd October 1844, the second son of a family of nine. His father, John Manson, was laird of Fingask and the Manager of the local branch of the British Linen Bank, and his mother, formerly a Miss Blaikie of Aberdeen, is said to have been a remarkable woman, possessing good looks, resourcefulness and some artistic talent. As he grew up and went to school, none discerned in Patrick any signs of unusual ability. Indeed, he was even regarded as dull and his peculiar interest in insects and worms was not encouraged.

At the early age of fifteen his parents apprenticed him to a firm of ironmasters in Aberdeen with whom his mother's family was connected, and here the boy worked until a breakdown in health obliged him to lie on his back with a curvature of the spine for all but two hours of the day. Those two hours were spent at the Marischal College of Aberdeen studying Natural History, and thus it was that, frustrated by illness in his attempt to earn a livelihood in business, he turned his mind to medicine.

Manson had finished his course and passed his finals before he was twenty. By the regulations he had to wait till he was twenty-one before he could

graduate M.B. of Aberdeen University. In 1866 he was appointed Medical Officer for Formosa to the Chinese Imperial Maritime Customs, and so began his connection with the tropics and tropical diseases, a connection pregnant with significance for future generations all over the world. For five years he worked at Takao, a port on the south-west of the island of Formosa, inspecting the ships that called there and treating the crews, and in the town itself he had his private practice, and attended a native missionary hospital where he came in contact with many tropical diseases unknown in England. He describes how he diagnosed as heart disease and prescribed accordingly for the complaint of a Chinese clerk whom he found "propped up in a chair, short of breath, dropsical from head to foot," and how, full of hope for his patient's recovery, he called next day and, to his surprise and chagrin, found him dead. He left the house a sadder and a wiser man. On looking back, when he had gained more experience of tropical diseases, he recognised he had been treating a case of beri-beri, a disease which up till then had been but a name to him.

After five years in Formosa, he moved to Amoy, a large town in one of the islands in the Bay of Hiu Tau where, as Medical Officer to the Imperial Maritime Customs, he had charge of a hospital for seamen and also of another missionary hospital for the Chinese. In spite of much prejudice against European doctors, he succeeded in establishing a medical school in connection with the hospital, where he could train the young Chinaman in the art of medicine. But it was uphill work and he was greatly hampered by the Chinaman's objection to operation

and to *post-mortem* examinations, and by his readiness to believe any tale, however bad, of the Westerner. On his arrival at Amoy the story was abroad among the native population, no doubt encouraged by the native doctors, that a poisonous pill, *Shan-si-fan*, was being distributed by Europeans to the detriment of the Chinaman. Such rumours were difficult to contend with. Eventually, however, when his work became better known, signs of confidence appeared, and it was even said that an antidote to *Shan-si-fan* could be obtained at the hospital.

Filarial disease, one of the most distressing complaints, with its various manifestations such as elephantoid tumours and chyluria, was very prevalent in Amoy as in other tropical places, and it was a subject about which very little was then known. Surgical operation for the removal of the tumours was in many cases abundantly necessary, but at first the natives could not be induced to submit to it. By a stroke of good fortune, Manson was enabled to give a practical demonstration of the value of surgery. A youth of nineteen, who had been weighed down for five years with an elephantoid tumour, had become such a burden to his family and so repulsive in appearance that they went the length of suggesting to him that he should somehow end his useless life. At last the physical and mental torment became so unbearable that the lad twice attempted suicide by swallowing arsenic. But he took so much that he was violently sick before the poison had time to take effect. It then occurred to him that he might just as well be killed by the foreign surgeon at Amoy of whom it was said that he removed tumours with a knife. He therefore submitted himself to Manson for operation,

saying, when he was warned of a possibly fatal outcome, "I have tried to kill myself twice but failed; if you succeed in curing me so much the better, but don't let the consideration of my death deter you in anything you care to do. I am not afraid of death." The operation was a complete success and the rumour of it spread abroad like lightning, as rumours do in Oriental lands, and the reputation of the hospital was greatly enhanced thereby. "In the course of the next three years," says Manson's biographer, Colonel Alcock, "more than a ton of superfluous elephantoid tumour was removed from the population of Amoy," and during the first three years of Manson's charge the number of patients treated rose from 1980 in 1871 to 4476 in 1874. Manson calculated that the mortality from smallpox alone in Amoy was as high as 33 per cent., and he did a great deal to encourage the practice of vaccination and to allay native prejudice against it.

In 1875 he returned to England with the intention of improving his knowledge of tropical pathology, and to learn all that was to be known of elephantiasis and chyluria. The fact that he could find no school in London where he could achieve this greatly impressed him, and was responsible for sowing in his mind the seed which in later years gave us the first School of Tropical Medicine. But in 1875 Manson was little known, and he had no introductions to the leading scientific men of the day. Failing to find any other source of instruction, he went to the British Museum. Here he read of Timothy Lewis's discovery of a microscopic worm (*Filaria sanguinis hominis*) found, first in a specimen of chylous urine and then in the blood of a victim of

chyluria in Calcutta in 1870 and in 1872. This was what he had himself been searching for, and, on his return to Amoy, he worked unceasingly in the hours that could be spared from his official duties to find this parasite, to trace its life-history, to watch the stages of its development and to discover how man became reinfected with it.

The worms discovered by Lewis were embryos. These had been seen as early as 1863, though Lewis was unaware of it, by a French surgeon, Demarquay, in Havana, but not in the blood. Calculating that in the blood of patients infected by worms, there were sometimes as many as two million embryos, Manson endeavoured to discover what became of these, and how they made their escape from the blood, for it was evident that, even allowing for the ordinary means of exit from the human body by which some would escape, such a host could not all come to maturity without eventually killing themselves off by over-population along with their human victim. Suspecting the mosquito rather than any of the other blood-sucking insects of being concerned in this business, he fed some mosquitoes on the blood of a sufferer from filariasis. Then, examining the mosquito under the microscope, he saw a wonderful sight. In its stomach were the embryos of the parasite which it had sucked up, and here in this new abode he was able to record their growth from day to day. His delight in watching this process is well described in his own words: "I shall not easily forget the first mosquito I dissected. I tore off its abdomen and succeeded in expressing the blood the stomach contained. Placing this under the microscope, I was gratified to find that, so far from killing the *filaria*, the

digestive juices of the mosquito seemed to have stimulated it to fresh activity. And now I saw a curious thing. The little sac or bag enclosing the *filaria*, which hitherto had muzzled it and prevented it from penetrating the wall of the blood-vessels in the human body, was broken through and discarded." He discovered, also, the very remarkable fact that the embryos of the adult *filaria* disappear from the cutaneous blood of an infected man at certain times of the day, to reappear at sunset, and that during the period of their absence they are to be found attached to the capillaries of the lungs, or hooked on to the walls of the large arteries, although it was not till 1897 at the *post-mortem* of a *filaria* patient in London, that he found out where they retired to, when absent from the blood. Writing to Dr T. Spencer Cobbold, the noted helminthologist, in 1879, Manson gives a graphic description of the embryos' flight: "The young escape into the circulation at regular intervals of twenty-four hours, the discharge commencing soon after sunset and continuing till nearly midnight, from which time till the following noon their numbers gradually decrease. By two or four o'clock till six they are nearly completely absent. This is a striking and most suggestive fact, and in connection with it one might be tempted to speculate on the causes of the periodicity of malarial fevers. It is marvellous how Nature has adapted the habits of the *filariæ* to those of the mosquito. The embryos are in the blood just at the time the mosquito selects for feeding."

This momentous discovery of the mosquito as the intermediate host of the parasite, *Filaria sanguinis hominis*, in 1877, opened a new chapter in the annals

of science and pointed the way which led eventually to Ross's famous discovery twenty years later of the manner in which man is infected with malaria. These experiments were reported by Manson in the China Customs Medical Report for 1877 and by Cobbold to the Linnean Society in 1878, and again in 1883 by Manson to the Linnean Society. In these papers he describes in detail how the young of the adult *filaria* are withdrawn from the human blood, and go through a process of development in the body of the mosquito before they can infect another human being. "When the mosquito penetrates a blood vessel," he says, "the passing embryos, lashing about as is their habit, entangle themselves on the proboscis and get sucked up." The idea that blood-sucking insects might have some connection with disease, especially fevers was, of course, not new in Manson's time. It was a common notion among natives in many tropical countries, but what part they played and how was quite unknown, although Leuckhart in 1858 had shown that the guinea-worm develops in the water-flea. Manson's discovery established the fact of the part mosquitoes play as intermediate hosts, a necessary stage in the development of the parasite, and disclosed, in Colonel Alcock's words, "a new and far-reaching principle of the necessary intermediation of the blood-sucking insect as a causal factor in the sphere of disease." But at the time, the discovery did not attract anything like the attention it deserved, nor was its full significance realised till long after. He was working alone in a far-off part of the world, isolated from schools of research, and in the intervals of leisure that a busy practice allowed. "Men, like myself, in

general practice," he said in his letter to Dr Cobbold, "are but poor and very slow investigators, crippled as we are with the necessity of making our daily bread." Manson hoped to discover where the adult *filariæ* lodged in the human body, and although he did not accomplish this until after they had been seen by Bancroft in 1876, and by Lewis a little later, nevertheless, he predicted before these discoveries were made where the adults would be found—in the lymphatic system.

In December 1883, Manson left Amoy to take up private practice in Hongkong. There he started a Medical College, which was the origin of the present University and Medical School of Hongkong. In his inaugural address to this College he said: "I can conceive no grander position or opportunity for any man to have, than that we offer to each of our students. At his back the whole of European Science, before him 300,000,000 to whom to give it." And, as illustrating the difficulties and prejudices with which the Chinese student would have to contend, he said, referring to the traditions of Chinese medicine, "For example, as every foreigner soon gathers from his native friends or his servants, every article of food, of drink, and every medicine is classified according as it is considered a heating or a cooling thing. In keeping with this, every disease is classified a hot disease or a cold disease. It is evident that a hot disease requires a cooling diet and medicine, and a cold disease a heating diet and medicine. The delightful simplicity of this has laid a very firm hold on the popular mind. It is a style of logic that catches the uneducated. It has a pseudo-scientific air about it that is taking. It enables the layman, he thinks, to

argue with his doctor on an equal footing. It is a sort of medical logic that has often filled the pocket of the European quack, and it is equally productive in China. It is one of those touches of Nature we meet everywhere, and proves the kinship of the whole world."

In 1889 Manson left China and settled in London, at 21 Queen Anne Street, and in May 1892 he was appointed Physician to the Seamen's Hospital Society and had charge of a ward at the Albert Dock Hospital. Here the constant influx of natives from the tropics kept him in touch with tropical diseases, and here, later, he was chiefly instrumental in founding the first School of Tropical Medicine in London.

The subject of malaria was now occupying a great deal of his thought, and about this time he published his famous mosquito-malaria hypothesis, which formed the basis of the researches for the malaria parasite after it leaves the human blood and before transmission to another human being. This parasite (*Plasmodium*) had been discovered by Laveran in 1880; the method by which man became reinfected by it was still quite obscure. With the results of his researches on filaria in mind, Manson suggested that the malaria parasite should be sought for in the body of the mosquito, which had been fed on malaria-infected blood; that its development would be traced in the tissues of this insect; that, when the time was ripe, it would be transmitted in some manner to another human being. He surmised that man might become infected by drinking the water in which the infected mosquito had died, but in this he was mistaken. Working in London, Manson himself had not sufficient material at his command to carry out these researches. He said,

however, "The hypothesis I have ventured to formulate seems so well grounded that I for one, did circumstances permit, would approach the experimental demonstration with confidence." And we may be sure he longed to be under a tropical sun where he could accomplish this. But the young men were not wanting to answer his call. Among them Surgeon-Major Ronald Ross went to Queen Anne Street. So inspired was he by the mosquito-malaria theory, that he undertook to verify it by experiment. From this date onwards, Manson kept in constant touch with Ross's work in India, and helped him continually by encouragement and advice. At home he did all he could to interest scientists, notably Lord Lister and those in authority, in Ross's researches. The malaria parasite was traced by Ross in the stomach of the mosquito (of the genus *Anopheles*) which had been fed on the blood of a malaria patient, and in 1897 he traced its growth within the body of the mosquito till it reached the salivary glands of this insect. Then the mystery of the retransmission of infection to man was solved, for it was plain that this was accomplished by a bite from the *Anopheles*. At the meeting of the British Medical Association in Edinburgh in July 1898, Manson launched upon the world the news of Ross's great discovery, which was destined to revolutionise the life of the white man in the tropics.

Manson was appointed Medical Adviser to the Colonial Office in 1897, a position which gave him the opportunity of re-organising and co-ordinating the work of medical officers in the Colonies. He had long had in mind a scheme for instruction in tropical diseases, remembering how, as he pointed out at a

later date in his inaugural address to the Society of Tropical Medicine and Hygiene in 1907, he himself had been twice disappointed when he came home on leave from China, hoping to hear in London the latest news of tropical medicine: "I once more came to London on furlough," he said, "in the year 1882-83 to learn the latest in medicine and surgery, especially in their application to tropical medicine. I heard plenty about the tubercle bacillus, but, although I visited the societies and became acquainted with many medical men of standing, I did not once hear of Laveran's important discovery of the malaria parasite. . . Had there been a Society (of Tropical Medicine) in 1883, doubtless Laveran's discovery would have been a prominent subject for discussion, the technique for its demonstration would have been familiar to the Fellows, and I should have gone back to China in a satisfactory position to pursue the study under favourable conditions. I lost ten years by this."

In an address delivered at St George's Hospital in October 1897, he made a vigorous appeal for Government support for the establishment in London of a School of Tropical Medicine, where all medical students desirous of instruction should be admitted, and where those who returned from the tropics could learn the latest developments in tropical medicine. As a result of the publicity given to this address, Mr Joseph Chamberlain, then Colonial Secretary, took the matter up, and the Seamen's Hospital Society generously acceded to his request to found a School for the study of tropical diseases at the Albert Dock Hospital. In October 1899, the School held its first session.

In 1898 Manson was appointed Lecturer on Tropical Diseases to the Royal Free Hospital for Women, and in this year he published his *Manual of Tropical Diseases*, a book which ran into six editions in the next twenty years and was regarded as the standard work on the subject. He received many honours. In 1900 he was elected a Fellow of the Royal Society, and received the C.M.G. In 1903 a knighthood was conferred upon him, and in 1904 Oxford University gave him the honorary degree of D.Sc. In 1912, on his retirement from the Colonial Office, he was awarded the G.C.M.G. "in recognition of his eminent services in connection with the investigation of the causes and cure of tropical diseases," and in 1921 he received the LL.D. of Cambridge University. Many foreign societies bestowed their honours upon him, and he was President of the Epidemiological Society, and the first President of the Society of Tropical Medicine and Hygiene.

Manson had been a lifelong sufferer from gout and, in consequence of his ill-health, he retired to live in Ireland in 1912 when his arduous duties at the Colonial Office came to an end. The War, however, brought him back to London, and to the last he took a very lively interest in the work of the School of Tropical Medicine, visiting it in its new home in Endsleigh Gardens shortly before his death in April 1922. In these last days he often talked over the project of the incorporation of the School with the London School of Hygiene and, although he did not live to see the erection of the present magnificent building in Gower Street, which the generous gift of the Rockefeller Foundation has made possible, his name will always hold a high place

Main Entrance of the London School of Hygiene and Tropical Medicine.
From a drawing by J. D. M. Harvey.

in connection with its work, for he may truly be called the founder of the original School in London, as he is the "Father of Tropical Medicine." Future generations of students, equipped with all the benefits the School can give, will remember thankfully the work of Patrick Manson, done in complete isolation at the beginning of his career, for the benefit of mankind.

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ALPHONSE LAVERAN, M.D.

1845-1922

Alphonse Laveran, the distinguished discoverer of the malaria parasite, was brought up in an atmosphere which profoundly influenced his future career. Under his father's guidance, he learnt at an early age those methods of accurate observation that characterise the work of the scientist and was trained in the rigorous discipline that the cause of truth demands, and could not but be affected by the quiet spirit of enthusiasm which pervaded his home-life.

His father, Dr Louis Laveran, born in 1812, was a native of Dunkirk, where his father before him had followed the profession of medicine. He had a distinguished career in the Army Medical Service, being appointed at the age of twenty-nine to a professorship in the military hospital of Metz and, after serving in Algeria and carrying out researches on malaria, returned to Paris to fill the Chair of *Maladies et Epidémies des Armées* at the Val-de-Grace, a school of which he afterwards became director. Louis Laveran was known as a man of great uprightness and strong character, broad-minded and good-hearted and faithful in his friendships. His strong sense of duty and of justice, combined with his brilliant professional qualities, earned him the respect and devotion of his pupils. While at Metz, he married Mademoiselle de la Tour, who was descended on her mother's side

Alphonse Laveran
1845-1922

From an etching after E. Boilvin, reproduced by permission of Messrs Masson et Cie.

from the Lallemand family of Metz, a name famous in history for the part played by the Generals Lallemand at the Battle of Waterloo, and for the exile which was their fate on the return of the Bourbons to power.

Alphonse Laveran was, therefore, a son and grandson of distinguished physicians on his father's side, and a great-nephew of celebrated soldiers on his mother's side, and inherited the characteristics of both families, retaining all his life a love for the army along with his inconquerable devotion to science. Born at Paris on the 18th of June 1845, he accompanied his parents to Algeria when he was five years old, and spent his early childhood running free among the orange groves of Blidah, with his father alone to teach him. He retained in after years delightful memories of this country.

On the return of his family to Paris in 1856, he attended the schools of Sainte-Barbe and Louis-le-Grand and, finally, choosing his father's profession, entered the *École du Service de Santé Militaire* at Strasbourg in 1863, taking the four years' course under the excellent teachers who were then on the staff of the Medical Faculty, a course which at that time was considered in some respects superior to that of Paris. In 1866 he served as resident medical officer in the civil hospital at Strasbourg, before attending a course at the Val-de-Grace in Paris, and, on leaving this school, was appointed *Aide-Major* at the military hospital of St Martin's. During the Franco-German War in 1870, he saw active service in the besieged town of Metz, and witnessed in these days before antiseptic surgery was employed, or typhoid fever inoculation known, all the horrors and

suffering which overtook the besieged French Army, when septicæmia, erysipelas and gangrene made havoc of the wounded, and typhoid and dysentery raged, amid scarcity of food, medicines and hospital equipment. Alphonse Laveran was present, too, on the fatal day in October 1870, when the garrison surrendered and the town of Metz, "so French," "so patriotic," as Madame Phisalix, his biographer, describes it, was handed over to the Germans, and the tocsin sounded the doom of an anguished, silent people.

In his capacity of doctor, Laveran obtained a passport from the enemy and returned to France through Belgium, serving in the military hospital at Lille till the end of the war.

In 1873 he was attached to the 10th Hussars at Pontivy, and in the following year passed the examination for a fellowship at the Val-de-Grace with distinction, and was appointed *Professor agrégé des Maladies et Epidémies des Armées* at this school, holding the Chair which his father had held before him. Many of the students of the Service de Santé Militaire who attended his lectures here, carried away with them lively recollections of his vigorous teaching, and his demonstrations of practical work with the microscope. He demanded of his pupils the same inflexible discipline which he applied to his own work, and many a young man owed to Laveran's unrelaxing training in the search for truth, the success which attended his after-career. To Laveran, says his biographer, from the time that he entered the Army Medical Service, his life and his work, both professional and scientific, were one and indivisible, for his life was one long devotion to work, lasting fifty-five years,

a devotion which death alone dispelled. All other activities were subordinated to his work, were reduced to the indispensable minimum, and submitted, like the work itself, to an inexorable discipline which the passage of years did not lessen.

Laveran was a prolific writer, and his work appeared in more than 600 publications, of which a few are concerned with every branch of medicine; but the majority treat of the protozoa, the single cell organisms, in their relation to diseases. Before his time a few protozoal parasites had been found, but their pathological significance had not been shown.

In 1875 he published a treatise, suggested by his father's work in epidemiology, entitled *Traité des Maladies et Epidémies des Armées*, and in 1878, the professorship at the Val-de-Grace being terminated, he was attached to the military hospital at Bône in Algeria, where he had ample opportunity of studying malaria. For many years French physicians had done much distinguished work in this country on malaria, and had recognised as characteristic of the disease the pigmentation of the organs caused by small black granules, appearing like specks in the cells of the blood of fever patients; but these had been attributed to the deterioration in the blood itself brought about by a poisonous gas, the "marsh-miasma," as it was called, to which cause it was supposed the fever was due. On arrival at Bône, Laveran soon verified all the work his predecessors had done before him and, by placing fresh unstained drops of blood from living patients under the microscope, discovered that the granules were usually to be found, not free in the blood itself, but wrapped

in small clear cysts within the red or the white corpuscles, or in crescent-shaped bodies; and he at once suspected that these cysts, containing the black pigment, were living organisms of a parasitic nature, rather than a degeneration of the blood as had formerly been supposed. His researches, however, at this point were interrupted for, on being promoted to the rank of Surgeon-Major, he was transferred to Biskra, a place so free of fever that there was little opportunity of studying it. His attention was there directed to the disease known as Biskra Boil, a complaint in which he maintained his interest later on, and in 1879 he published, with Dr Tessier, a work in two volumes, entitled *Les Nouveaux éléments de Pathologie et de Clinique médicales*, which had passed through four editions by 1894. It was not till he was stationed at the Military Hospital at Constantine, where malaria was rife, that he was able to continue his search for the parasite. There, on the 6th of November 1880, a memorable day in the annals of tropical medicine, while examining the blood of a soldier suffering from malaria, he saw the parasite whose existence he had previously suspected, a small pigmented body, with its slender threads (the flagella) thrust out, actively lashing about among its neighbouring cells. From that moment he had no longer any doubt of the parasitical nature of these bodies, nor did he hesitate to place them among the *Hematozoa*. Subsequent researches showed that these parasites were only found in the blood of malaria patients, and never in the blood of persons suffering from any other disease. When in Italy in 1882, Laveran found the same parasite at work in the fever stricken district of the Campagna.

This discovery was communicated to the *Académie de Médicine* on the 23rd and 28th of November 1880, and to the *Académie des Sciences* on the 24th of October 1881, and again in October 1882. The full account of these researches was first published in his *Traité des Fièvres Palustres* in 1884. He had observed the parasite in 432 cases of malaria and named it *Oscillaria malariæ*, though it afterwards became known as *Plasmodium malariæ*. The announcement of this news was greeted with scepticism, for it was not the first time that micro-organisms found in the blood had been claimed to be the cause of malaria. Furthermore, the technique for studying the parasites was still in an elementary stage, making it difficult for others to verify Laveran's work and, owing to the fact that in Algeria, quartan, tertian and malignant fevers, each with their separate parasite, abounded and confused the investigator in his attempt to follow one of them through all its different stages, Laveran had not been able to trace the life-history of the *Plasmodium*. This was afterwards done by Golgi in Italy, where only quartan fever existed. But it was many years before the existence of the malaria parasite was generally recognised, and it was not till twenty-eight years after the discovery had been made, that a memorial tablet was placed in the hospital at Constantine to commemorate the event.

In 1885 Laveran married Mademoiselle Pidancet of Montoy-Flanville near Metz, his wedding being celebrated in the village church at Noisseville, famous for the battle which was fought there during the siege of Metz. The marriage was a very happy one, for his wife appreciated his enthusiasm for his work,

and understood well how necessary are peace of mind and freedom from the ordinary cares of every day to the original investigator.

For a decade, from 1884 till 1894, Laveran held the Chair of Military Hygiene at the Val-de-Grace in Paris, and in these years laid the foundations of a sound teaching in this science, emphasising the benefits to be derived from practical instruction as well as theoretical, and founding a Museum of Hygiene. His *Traité d'Hygiène Militaire*, published in 1896, was greatly appreciated in the Army.

The *Académie des Sciences* awarded him the Breant Prize in 1889 in recognition of the discovery of the *Plasmodium*, and two years later the publication of his second work on malaria, *Du Paludisme et de son Hématozaire*, was received with more enthusiasm by the medical world than had been accorded to the announcement of this great discovery eleven years before. Honours were now bestowed upon him by many learned societies. He was elected a member of the *Société de Biologie*, and in 1893 a member of the *Académie de Médecine*, Correspondent, and later Fellow, of the *Académie des Sciences* in 1895, and a Commander of the *Legion d'Honneur*.

On the termination of the professorship at the Val-de-Grace in 1894, Laveran hoped to be appointed to some position where he would be able to carry on his research work. The authorities, however, ignoring his great talents, made no provision for this, and for the next two years he was occupied as Director of the military hospital at Lille and afterwards at Nantes, doing work for which he had little liking, and deprived of a laboratory and all facilities for research. It was expected in 1895, when the Govern-

ment sent an expedition to Madagascar, that his services would be employed to protect the troops in a country where malaria was the greatest enemy they would encounter; but he was not sent with the forces, and the many graves erected to those soldiers who died of fever in the island, testify to the price the Army paid for this omission. In 1896, finding that all opportunities for research were still denied him, he resigned from the Army at the age of fifty, refusing to reconsider his decision despite all the efforts of his colleagues in the military corps to get him to change his mind. Thus the corps, to whose service his work had been so generously devoted, lost one of its most brilliant men.

He was enthusiastically welcomed at the Pasteur Institute by Pasteur's distinguished disciples, Duclaux and Roux, and here for the next twenty-five years he laboured, sparing himself not at all as the years accumulated behind him, punctual at his laboratory by eight o'clock every morning, allowing nothing to interfere with the vital interest of his life, his work. In collaboration with M. Mesnil, he returned to his researches on the protozoa, publishing many interesting accounts of several new parasites discovered, and carried out many investigations of the *trypanosomes* (the parasite of sleeping sickness) of men and animals, being responsible for the programme of the French Commission on Sleeping Sickness to the Congo. He took part in the conference on this disease in London in June 1907 after the return of the English Commission from Africa, where Bruce had identified the parasite which causes sleeping sickness, the *Trypanosoma Brucei.* Laveran's work on these parasites was published in an important volume,

entitled *Trypanosomes et Trypanosomiases* in 1904, in collaboration with M. Mesnil, a second edition being brought out in 1912.

But amid all the work on new parasites Laveran had not lost sight of the work still to be done on malaria. Although he had identified the parasite which causes the disease, there was still nothing known of its history outside the human blood. A vain search for it had been made in water, in the air and in the soil. As early as 1883, Dr King in America, who had not heard of Laveran's discovery, had given numerous reasons for supposing that mosquitoes inoculate men with malaria brought from the marshes, and Manson's famous mosquito-malaria hypothesis, based on his own discovery of the part played by this insect in the transmission of the parasite which causes chyluria, was published in 1894. Meanwhile, Ross in India was hard on the track of the parasite *Plasmodium malariæ*, as it developed within the body of its host, the mosquito of the species *anopheles*, and his great discovery of how this insect not only takes the microbe out of the blood of the fever stricken patient, but after developing it within its own body, also puts it back again into the blood of man through its bite, was announced by Manson in Edinburgh in 1898. Laveran was among the first to support Ross, and by his researches on the different kinds of mosquitoes sent to the Pasteur Institute from all malarious countries, showed that in all places where malaria was, there also was the mosquito *anopheles*, while in those parts of the country free from fever this breed was not to be found.

Ross's discovery of the mode of transmission of malaria crowned Laveran's work of 1880 and opened

the way for the prevention of malaria in tropical countries on a scale that had never been dreamt of before. In a paper read before the *Académie de Médecine* in 1901, Laveran made a proposal for the foundation of a Society of Sanitation for Corsica, giving full details of the preventive measures to be employed. This society, under the name of *Ligue corse contre le Paludisme*, was founded in the following year with Laveran as its Honorary President, and his post was no sinecure, for he visited Corsica in 1902, made a study of the habits of the anopheles mosquito wherever it was to be found, assured himself that preventive measures were properly applied, and, when it was alleged that malaria existed in several places where no mosquitoes of this breed were present, he immediately visited the spot indicated, and invariably found the *anopheles* without trouble. He published in 1903 a small volume entitled *Prophylaxie du Paludisme*, giving concise and clear directions for the protective measures to be adopted against malaria. Sir Ronald Ross has pointed out that Laveran's "great discovery of 1880 was not connected in any way with the science of medical bacteriology—which had been recently founded by Pasteur, Lister and Koch—but with the much older science of animal parasitology."

From 1903 onwards, Laveran was engaged in the study of the diseases known as *leishmaniases*, from the fact that Sir William Leishman first identified their causative agents—Indian and Mediterranean kala-azar and the Delhi and Biskra boils. Many observers had thought that Mediterranean and Indian kala-azar were distinct diseases till Laveran established their identity. His work on this subject, entitled *Traité de leishmaniases*, was published in 1917.

Many foreign societies had now recognised Laveran's work. He received the Jenner Medal of the Epidemiological Society of London in 1902, was awarded the Moscow Prize at the 15th International Congress at Lisbon in 1906, and won the Nobel Prize for Physiology and Medicine for his researches in protozoology in 1907. He was elected a Foreign Member of the Royal Society in 1916, an Honorary Member of the Medical and Surgical Society of London, of the Royal College of Physicians of Edinburgh, of the Pathological Society of Great Britain and Ireland, and of the Society of Tropical Medicine and Hygiene.

When in 1907, owing to the great expansion of its work, the Pasteur Institute acquired a building for additional laboratories in the rue Falguière, Laveran was allotted the second floor on which he established his famous *Laboratoire des Maladies Tropicales*, to the equipment of which he devoted the proceeds of his Nobel Prize. To this spot in the gay city of Paris came students and research workers from all points of the compass to study under the master, and here Laveran worked with unrelaxing zeal till the end of his life. During the War years when he served on numerous commissions for the hygiene of the troops, and when every member of his staff had gone to the Army, he carried on in his laboratory with the sole aid of his faithful assistant Léon Breton. In June 1915, on the anniversary of his seventieth birthday, he received congratulatory addresses at the Pasteur Institute, and Dr Roux, with the precision and clarity which characterised all his utterances, gave a remarkable account of the lifelong work of Alphonse Laveran.

But Laveran's work was not yet done. From 1919 to 1921 he published the results of researches with Dr M. G. Franchini on the flagellate parasites of insects, giving an account of the technique for obtaining them in pure culture, and of the infections for which they are responsible. It was remarkable with what vigour he sustained his active interest in the work of the laboratory up till the very end. But in 1920, when as President he addressed the *Académie de Médicine* at its centenary meeting, it was noticeable that his strength had begun to wane, although he delivered an interesting discourse with the rigorous conscientiousness that allowed no personal consideration to interfere with his work. When at last his physical forces began to decline, he faced the end with a stoicism and a consideration for others which was the admiration of all his friends. Once he knew that medical science could do no more for him, he resigned himself to his fate and, after an illness of a few months, the only one that had interrupted his long life of labour, he died on the 18th of May 1922.

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MAJOR WALTER REED, M.D., LL.D.

1851-1902

Since the days of Washington, the soil of Virginia has seen the birth of many famous sons, whose names have gone to swell the ranks of America's honoured dead, and not least among them, if we take the measure of his services to humanity, is the name of Walter Reed. In a short life of fifty-one years, this true Virginian had the rare satisfaction of seeing the tangible results of his brilliant researches applied, and so ably applied, by the administrative genius of the great sanitarian, General Gorgas, to the fever-ridden lands of the South, that they were henceforth free from the scourge of centuries, yellow fever.

Walter Reed, the sixth child of the Reverend Lemuel Reed and his wife Pharaba, whose maiden name was White, was born on the 13th of September 1851, at Belroi, in Gloucester County, Virginia. Both his parents were North Carolinians by birth and came of English stock, his father being a Methodist minister. Their means were modest, but not so scanty as to deprive their children of a sound education, and Walter Reed, after being at private schools, entered the University of Virginia at an early age, graduating M.D. there in 1868, when he was only seventeen, the youngest graduate on record. From there he went on to Bellevue Medical College, New York, where he took a second medical degree,

WALTER REED
1851-1902

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afterwards holding appointments in Brooklyn City Hospital and the City Hospital, Blackwell's Island. He was not yet twenty-one when he became a district physician in New York City, and only twenty-two when he was appointed one of five inspectors of the Board of Health of Brooklyn, so that his connection with the then quite new science of Preventive Medicine, began at an early stage of his career. Entering the Medical Corps of the United States Army in 1874, he received his commission in 1875 and, as assistant surgeon with the rank of 1st Lieutenant, was stationed at Willet's Point, near New York Harbour, and here, after a year, he married Miss Emilie Lawrence of Murfriesboro. He then left New York and saw service in Arizona, Nebraska, Dakota, and in the Southern and Eastern States, in out-of-the-way stations on the frontier, where a scattered population involved long rounds on horseback to visit his patients in their far-distant homes, and where he had to treat every kind of illness single-handed, with none of the facilities which are the heritage of those whose work lies in the city. But the dearth of mechanical aids and the absence of consultation with colleagues bred in him an independence and self-reliance and skill in diagnosis, with habits of accurate observation which served him well in after life. It was, however, a very lonely life and Reed, a student by nature, felt the isolation of the West, the lack of contact with other minds, and the need of keeping in touch with the developments of science. He therefore applied in 1889 for a post in Baltimore, and was appointed examiner of recruits there in 1890.

In Baltimore, Walter Reed's true scientific career may be said to have begun. He studied pathology

and bacteriology, new sciences at that time, under Professor Welch at Johns Hopkins University, and was greatly encouraged by the interest and friendship of this distinguished teacher. In 1892 he published his first scientific paper on "The Contagiousness of Erysipelas," in the *Boston Medical and Surgical Journal*, following it in 1893 with "Remarks on the Cholera Spirillum," in the *North-west Lancet*, St Paul. In this year he was appointed Curator of the Army Medical Museum and Professor of Bacteriology at the new Army Medical School. On account of his excellent judgment, he was often sent on expeditions to investigate the causes of epidemics at military stations; but in spite of the many interruptions that this, and his work as an examiner involved, his output of scientific work, as evidenced by the papers he published from the time he went to Baltimore until he left Washington in 1898, a period of ten years, testifies to his enormous industry and even then established his reputation as an original investigator. "The Germicidal Value of Trikresol" appeared in the *St Louis Medical and Surgical Journal* in 1894, and *A Brief Contribution to the Identification of Streptococcus Erysipelaticus* was published this year. In 1895 two papers on typhus fever appeared, and in 1896 the *Parasite of Malaria* was published, and many others, all of them records of his painstaking experiments.

When the Spanish American War broke out in 1898, an epidemic of typhoid fever ravaged the camps of the Volunteer troops of the American Army, and Reed was appointed Chairman of a commission to inquire into the causes of the fever. His fellow commissioners were Dr V. C. Vaughan of Ann Arbor and Dr E. O. Shakespeare of Philadelphia.

The work of this commission occupied them for a year and was carried out with great skill and attention to detail in the investigation of hundreds of cases of typhoid. Its report revealed many new aspects of the disease, and was of value in proving that typhoid fever can be communicated by contact with infected articles such as clothing, as well as by contaminated drinking water.

Reed was next sent by the Government to Cuba at the head of a commission to investigate the causes of yellow fever. Among the American troops stationed at Havana when the war ended, this disease was taking its usual heavy toll of valuable lives. In association with Dr James Carroll before the war, Reed had already investigated a claim made by Sanarelli that the *Bacillus icteroides* was the cause of yellow fever, a theory which was generally regarded as justified at that time. As a result of the experiments they then carried out, it was conclusively proved that this bacillus is a variety of the hog-cholera bacillus, which is to be found all over the United States, and that even if it is present in cases of yellow fever, it has no connection with that disease. These conclusions were now borne out by Reed and his fellow commissioners, Dr Carroll, Dr Lazear and Dr Agramonte, a Cuban who having had the disease was immune, in their experiments at Havana in 1900, where in the thick of an epidemic they set to work in the small town of Pinar del Rio. That year a distinguished officer of the United States Public Health Service, Dr R. H. Carter, had drawn attention to the fact that, although the incubation period of yellow fever was only five days, yet a house to which a patient was conveyed did not become infected until

fifteen to twenty days had elapsed. The significance of this fact was not lost on Reed and, comparing it to the incubation period of the malaria parasite in the body of the mosquito, discovered in 1897 by Sir Ronald Ross, he decided to seek for the means of transmission of yellow fever rather than for the specific agent which caused the disease, which had hitherto occupied scientists. The minute spiral organism which causes the disease was not discovered till long after Reed's death, when it was observed by the Japanese investigator Noguchi, in 1918. The theory of the part played by the mosquito in the transmission of yellow fever was not new, for Carlos Finlay, a Cuban of English stock, had advanced it as early as the eighties, and had even distinguished the mosquito which was the culprit, but had failed to give experimental proof of his claim, for the reason, not then known, that it is only during the first three or four days of the disease that the blood of a yellow fever patient is infectious. He had selected for his experiments, patients in whom the disease was well advanced and whose symptoms were therefore more pronounced, and so had missed the infective period, and his mosquitoes, fed on the blood of these patients, were unaffected. Had he succeeded in this experiment, thousands of lives would have been saved in Cuba and the Southern States in the twenty years that elapsed before Reed's brilliant work was done. Instead, the theory that infection was conveyed by contaminated clothing and bedding still held the day in 1900, and every year much valuable property was destroyed.

The Military Governor of Cuba, General Leonard Wood, was a man of broad outlook and scientific

training, who appreciated the value of Reed's work, and readily made provision for all the necessary means for the experiments. Rewards were offered to men submitting themselves for trial, and many soldiers of the American Army volunteered. The heroic story of Camp Lazear is famous in the records of science. Dr Carroll was the first to allow himself to be bitten by a mosquito which twelve days previouly had been fed on the blood of a yellow fever patient. He developed a severe attack of the disease, but recovered. Dr Lazear was not so fortunate. He also had allowed himself to be bitten, but did not catch the infection, until, a few days later, in one of the fever wards, he was accidentally bitten, developed the disease in one of its worst forms, and succumbed. In his honour, his comrades named the experimental camp, established at Quemados about four miles from Havana, Camp Lazear. The next experiment was made on a young private, who was kept in camp for two weeks so that there was no risk of his being infected from any source other than that which the experimenters intended. At the end of that time an infected mosquito was allowed to bite him, and in three days he contracted the disease, and was removed to the fever hospital about a mile from the camp. Many other experiments of a like nature proved beyond a doubt that the mosquito was the means of transmitting the disease, but it had also to be shown that the infection could not be caught from clothing. For this purpose, a hut of two compartments, divided by a fine-meshed wire screen, was erected. In one compartment clothing and contaminated linen from the beds of fever stricken patients were placed; in the other some infected mosquitoes were let loose. Three

gallant volunteers, Dr Cooke and two private soldiers, slept for twenty nights on the contaminated bedding, but did not catch the disease. They then went into the next compartment, where they were freely bitten by their mosquito hosts and straightway developed yellow fever.

Many more experiments were carried out until Reed was absolute master of the situation. It was found that the disease could be produced by the subcutaneous injection of blood taken from a yellow fever patient in the first two or three days of his illness and, in all, ten cases of the disease were originated by bites of purposely infected mosquitoes; but no one in that famous camp got yellow fever except at the express desire of the Fever Commissioners, so admirable was the work of these distinguished investigators. General M'Caw has summed up the main conclusions of the Commission briefly and clearly in his monograph, *Walter Reed: A Memoir*, in the following words: "(1) The specific agent in the causation of yellow fever exists in the blood of a patient for the first three days of his attack, after which time he ceases to be a menace to the health of others. (2) A mosquito of a single species, *Stegomyia fasciata*, ingesting the blood of a patient during this infective period, is powerless to convey the disease to another person by its bite until about twelve days have elapsed, but can do so thereafter for an indefinite period, probably during the remainder of its life." ("The mosquito is capable of conveying infection for at least fifty-seven days after contamination and possibly longer," *Kelly's Encyclopædia of American Medical History.*) "(3) The disease cannot in nature be spread in any other way

than by the bite of the previously infected *Stegomyia*. Articles used and soiled by patients do not carry infection." And he adds, "It has been well said that Reed's experiments will always remain as models in the annals of scientific research, both for the exactness with which they were adapted to the points to be proved, and the precaution taken that no experiment should be vitiated by failure to exclude all possible sources of error."

In 1901, Reed returned to Washington and took up his work as Professor of Bacteriology and Clinical Microscopy in the Army Medical School and of Pathology and Bacteriology in the Columbian University. He was an attractive teacher and his lectures were listened to with intense interest.

In the meantime, in Havana, General Gorgas had set to work on the preventive measures, based on the report of Reed's Commission, with the amazing result that in less than a year Havana was free of this scourge for the first time for a century and a half. The benefits to mankind in the tropics which this discovery brought about were incalculable; and to the United States they were hardly less. Epidemics of yellow fever had spread to New Orleans, Memphis, Charleston, Baltimore, Philadelphia, New York and many other towns, leaving desolation in their train. The epidemic of 1878 cost the United States over 15 millions of dollars, and in the epidemic of 1853 New Orleans lost 8000 lives.

In recognition of his services Harvard University conferred upon Reed the honorary degree of M.A. in 1902, and Michigan University that of LL.D.; but he did not live long to enjoy the fruits of his work, for he was taken ill with appendicitis in the autumn

of this year, and, although an operation was performed, he died in Washington on the 22nd of November. His tombstone in Arlington Cemetery bears the inscription: "He gave to man control over that fearful scourge, Yellow Fever." His was a discovery which, as the Military Governor of Cuba said, resulted in the saving of more lives annually than were lost in the Cuban War, and in the annual saving of more money than was expended in the Cuban War from its opening to its end. But the discoverer died a poor man.

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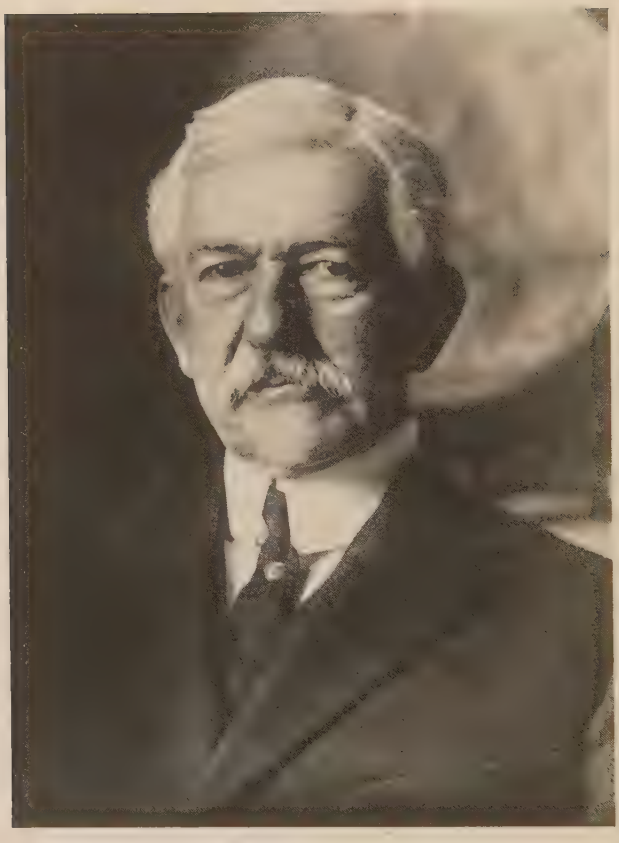

William Crawford Gorgas
1854-1920

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GENERAL WILLIAM CRAWFORD GORGAS, M.D., D.Sc.

1854-1920

It is but a few years since there passed from us in London, just at the start of his last mission to combat yellow fever in West Africa, General William Gorgas, "America's Ambassador of Mercy," as he has been aptly called, "the benefactor of humanity and the redeemer of the tropical world."

There are few stories of the miracles of old as wonderful as the tale of Gorgas's work in the Panama Canal Zone. That equatorial region, for centuries the greatest plague spot in the world, described by Sir Patrick Manson as one of the great tropical disease centres, a place where germs may flourish all the year round because there is no cold season to destroy them, was transformed by Gorgas in the twinkling of an eye into a healthy, habitable region. Within a year of his coming, he rid the place of yellow fever and reduced a death-rate of from 40 or 60 per thousand to one of 7 per thousand. It was little wonder the inhabitants looked upon him as the saviour of mankind. But to realise fully what he accomplished, we must have some idea of the conditions that existed before his advent. At the laying of the foundation stone of the Gorgas Memorial Institute of Preventive Medicine in Delaware, Dr Porras, a former President of the Republic of Panama,

recalled the early days of his youth. He said: "I can still remember, and it seems to me a horrible nightmare when, on my way to Bogota to finish my studies, I found it necessary to spend a night in Colon. Sleep during that night was impossible for me because of the constant and tormenting bites of the mosquitoes . . . tormentors so numerous that by clutching at the apparently empty air, I caught handful after handful. . . . In those days of long ago it was the most natural thing for one to promenade the city's thoroughfares holding a handkerchief to one's nostrils to keep out or lessen the stench contaminating the air as a result of the decaying vegetation. On every hand one encountered well-beloved friends hastening home in the grip of malarial chills or some equally pernicious fever. . . . Those days have passed never to return, and our tropical home has become one of the world's health resorts."

William Crawford Gorgas was born in Mobile, Alabama, on the 3rd of October 1854, and his name implies a Spanish origin. He was the son of General Josiah Gorgas who, during the Civil War, was in Command of the Ordnance of the Southern Confederacy, and later was President of the University of the South, at Sewanee in Tennessee. His mother was the daughter of Governor Gayle of Alabama. He was brought up in Richmond, Virginia, until the Civil War ended, when he was nine years old. As a boy Gorgas wanted to be a soldier, but the idea was not encouraged by his parents who had seen so much of war and, after graduating B.A. at the University of the South in 1875, he decided to study medicine and entered the Bellevue Hospital Medical College in New York. Even in his student days the gaunt

spectre of yellow fever, the dreaded scourge, considered then a most contagious disease, dogged his footsteps. While he was at College, an outbreak occurred at Memphis, and Gorgas, along with other fellow students, volunteered his services to attend the sick, but the authorities refused him permission to go. He had to wait a little while longer. In 1879 he graduated M.D. and, still bent on a military career, he entered the Medical Department of the United States Army. As 1st Lieutenant, he was stationed at Fort Brown, Texas, in 1880, when close-by, in Brownsville, a violent epidemic of yellow fever broke out, and spread with such alarming rapidity that appeals were made to the Government for help. The place was beyond Gorgas's sphere of work, but he immediately offered his services and was sent into the fever-stricken district. Here, among others, he attended Miss Doughty of Cincinnati, a visitor to Fort Brown, who had caught the infection. Her condition was so serious that all hope of her recovery had been abandoned, and it is said that her very grave was dug, but the unexpected happened; she pulled through and lived to marry Gorgas in 1885, when he was promoted to the rank of Captain. In the meantime, he himself contracted the disease, a fact, since he recovered, not without its advantages, for it rendered him immune for the future and enabled him to serve without peril in the yellow fever regions of the tropics.

Gorgas saw active service in Florida and in the Dakotas, and in 1898, when the Spanish War broke out, he was promoted to the rank of Major and Brigade Surgeon of Volunteers, and accompanied the military expedition against Santiago. When the

war was over, before the end of the year 1898, he was appointed Chief Sanitary Officer in Havana, a post which he occupied until 1902. During his service in Cuba the United States Government sent the Walter Reed Commission to Havana to investigate the cause of yellow fever, for Havana had not been free of this scourge for 150 years, and, although in 1881 Carlos Finlay had arraigned the mosquito as the carrier of this disease, his brilliant work had had to wait twenty years for corroboration. When Walter Reed's discovery was announced and the mosquito of the genus *Stegomyia fasciata* was convicted of being the carrier of infection from one case to another, Gorgas said to the general in command: "If that is the cause of yellow fever, and I believe it is, as I have worked with the Commission, if you will give me authority to do what should be done, I will eliminate it from Havana." The General replied, "Go to it." And in February 1901, Gorgas began the stupendous task of exterminating the mosquito from Havana. Remembering President Porras's description of how it was only necessary to stretch out a hand to close it on a fistful of these insects, we can well imagine that it was no simple task with which he was confronted. The order went out that every case, or suspected case, of yellow fever was to be screened with wire gauze, so that the room was made mosquito-proof, and all the mosquitoes in the house and in the neighbouring houses were destroyed. The eggs of the mosquito are laid in stagnant water, in puddles or any convenient receptacle that may be found round about the dwelling places of man. It is therefore not a difficult matter to destroy the larvæ, for oil scattered on the face of the water is sufficient to

kill them. By the middle of February, Gorgas had a hundred men employed in the work of destruction, clearing out every breeding place. Up to June, strict quarantine of patients was enforced, their houses and bedding being disinfected, but after June the quarantine was somewhat relaxed. The patient's case had to be reported, his house screened and a warning notice displayed outside. A guard, whose duty it was to report whether all sanitary regulations were strictly carried out, was attached to each case. These measures were paid for from the public purse. By September the disease had been eradicated, and Havana, for the first time in a century and a half, was free of yellow fever.

A table of deaths in Havana over a period of thirty-four years, illustrates beyond the shadow of a doubt the value of Gorgas's work. From 1873 to 1879 there were well over a thousand deaths in each year, 1876 having the high record of 1619. In other years the record varies from 300 to 800 with the exception of 1899, which had the low record of 103. In 1900 there were 310 deaths, but in 1901, during the second month of which Gorgas's preventive work began, there were eighteen deaths from yellow fever; and in 1902, 1903 and 1904, when the record ends, there were none. In recognition of this work in eliminating the disease from Havana, Gorgas was promoted to the rank of Colonel by special Act of Congress and was made Assistant Surgeon-General of the United States Army.

In 1904 he was appointed Chief Sanitary Officer of the Panama Canal Zone, an appointment which he held till 1907, when he was made a member of the Isthmian Canal Commission. For four hundred

years yellow fever had carried off by the thousand succeeding generations of men in the Isthmus of Panama. All attempts to construct the canal had been frustrated by this scourge. When the French under de Lesseps began their building operations in 1880, they lost by death during the nine years of their occupation which ended in the bankruptcy of the Company in 1889, 22,189 labourers, and in 1904 when the United States took charge of the Canal, a yellow fever epidemic was sweeping away the inhabitants by the thousand. Then Gorgas took command, and in one year's time yellow fever and malaria were wiped out from the Isthmus. Mr Wellcome, the founder of the Tropical Research Laboratories at Khartoum, paid a tribute to Gorgas's work in the evidence that he gave before the United States Committee for Foreign Affairs in January 1928. He had visited Panama at the request of the American Secretary of War in 1910 to report on the sanitary work. "I have never seen anything anywhere," he said, "that equalled the perfection of organisation, systematising and direction that I found under the administration of General Gorgas. Gorgas had gathered about him a wonderful staff." He went on to describe how he was taken "long cruises through the reeking Panama swamps" to see at first hand the difficulties which had to be overcome. "One of the various serious problems which have baffled many workers in the humid Tropics has been how effectually to destroy and keep under control the rank plant life that springs up in a night with overwhelming rapidity at the water's edge and in marshy places, forming cup-like receptacles that are filled by the rain and make abundant breeding

places for mosquitoes." The Panama Sanitary Staff succeeded in checking this growth by means of a powerful blast of burning petrol sprayed on to the roots of the undergrowth, and they scattered sand over the cup-like holes made by crabs on the sea-shore, for mosquitoes, contrary to traditional belief, can breed in salt water. Such was the perfection of organisation attained by Gorgas that his preventive measures were carried out at the small cost of one cent a day per man. From fifty to sixty thousand men were employed in the Canal Zone, and malaria was practically stamped out among them. "A finer piece of economic health control would seem to be impossible," said Mr Wellcome. Even the railway trains that crossed the Isthmus were searched by Gorgas's inspectors in "every nook and corner," not for taxable goods, but for straggling mosquitoes, with such precision and thoroughness was every detail carried out. The success that attended these efforts altered the face of the Western tropics for the white man. Mr Wellcome recalled how Stanley, in the face of the deadly fevers that attended his rescue of Livingstone, had at one time been convinced that the white man could not cope with malaria and the other diseases of equatorial Africa; but how, at his last public appearance, at a dinner given to Dr Andrew Balfour, now Sir Andrew Balfour, on his appointment to the Directorship of the Wellcome Tropical Research Laboratories in Khartoum, he admitted that, thanks to the work of the London and Liverpool Schools of Tropical Medicine, the deadly plagues that harassed mankind were being conquered.

The Liverpool School of Tropical Medicine recognised Gorgas's work in the Panama Canal

Zone by the award of the Mary Kingsley Medal in 1907, and he received the honorary degrees of the Universities of Pennsylvania, the South, Harvard, Johns Hopkins and others, and was elected President of the American Medical Association in 1909-10. He remained in Panama, serving on the Isthmian Canal Commission until the winter of 1913 when, at the invitation of the Chamber of Mines in Johannesburg, he went to South Africa to investigate the cause of the high death-rate from pneumonia among the native miners in the Rand, and by the improvements he effected there the death-rate was considerably reduced.

In 1914 Oxford University conferred upon him the honorary degree of D.Sc., and the American Museum of Safety awarded him its Gold Medal. In 1915 he and his fellow-workers received a vote of thanks from Congress for their services in connection with the construction of the Panama Canal. Without these services the construction of the Canal could never have been accomplished, and it is well that Congress recorded the States' indebtedness, for governments have been slow to recognise the invaluable work of Health Officers.

Promoted to the rank of Surgeon-General of the United States Army in 1914, Gorgas was again promoted in the following year, being made Major-General. In 1916 he spent three months in the tropics of South America at the head of a Yellow Fever Commission sent out by the Rockefeller Foundation, making surveys and plans for preventive measures. The year 1917 saw the entry of the United States into the War, and Gorgas was responsible for the organisation of the Medical Corps

of the United States Army. Before the War ended, he had 32,000 men in his medical corps, and a personnel, including nurses, amounting to very nearly 200,000. In order that the United States should have an Army composed of men of first-class physique, Gorgas proposed that the recruits should be examined by a Board of experts to include a dentist, oculist, aurist, pathologist, surgeon and physician. The expense of providing such a Board in every town of the United States was enormous. Nevertheless, it was done, and the health of the troops that crossed the Atlantic bore witness to the efficiency of the method. The residue left behind were to Gorgas but a fresh incentive to wage the war of preventive medicine, for out of 7,000,000 men examined only 4,500,000 were passed fit, which meant that one-third of the men of military age were found to be unfit. He had visions of a future when Sanitary Science by prevention of disease shall have routed the unfit from the United States of America.

During this period Dr Arthur M'Cormack, President of the Kentucky Board of Health, was sent by Gorgas to take charge of the work at Panama. In the evidence he gave before the Committee of Foreign affairs on the Gorgas Memorial Laboratory, he described an incident which well illustrates the care that Gorgas bestowed upon every detail of his work. "Upon arriving at Panama, I familiarised myself as far as practicable, with administrative procedure, and with what happened, for example, when a man telephoned to the sanitary inspector of his district that a mosquito had been found in his residence. . . . Soon afterwards I was fortunate enough to find a couple of mosquitoes in my house.

I telephoned down to the sanitary inspector. . . . In a few minutes a truck came up with the sanitary inspector and four or five labourers in it; and they spread themselves through that house looking for mosquitoes. And they knew just where to look. With their flashlights casting their beams behind everything that cast a shadow, they went everywhere. And in a very short time they found these two mosquitoes . . . caught them in a test-tube, with a little chloroform cotton in it, and, with a magnifying glass, soon found what kind of mosquito each was. They would then know whether it had bred in the house or whether it had come into the house from outside. This happened to be a kind of mosquito that flew against the wind, and always bred in shallow wet places on the ground. That meant that there was such a place somewhere near my house. . . ." But they did not stop there. The sanitary inspector fetched a map of the neighbourhood and, knowing that these mosquitoes flew against the wind, and knowing the direction of the wind for the few preceding days, he knew that they had come from a certain direction. So search was made in that direction, and on the following day a leak in a water-pipe revealed the place where the mosquito had bred. "We can understand very readily," said Dr M'Cormack, "from the perfection of that organisation, why the death-rate of Panama is half that of the ten best rates in the United States; and the rate of sickness in Panama is about one twenty-fifth of that in this country."

In 1918, having reached the age-limit of sixty-five, Gorgas retired from the United States Army, and immediately undertook the direction of the Yellow

Fever work under the International Health Board of the Rockefeller Foundation. He received the Distinguished Service Medal of the United States, and was made Commander of the Legion of Honour of France. At the urgent request of the British Government he arrived in London on the 7th of May 1920 on his way to West Africa to serve on a Yellow Fever Commission. The introduction of preventive measures in a civilised community which understands the aims of the regulations imposed is a simple matter compared with the difficulties that meet the administrator in countries where a large native population is not under efficient control, and, had fate permitted, it would have been interesting to see the results of Gorgas's genius for organisation on such a land as the West Coast of Africa. But Gorgas never reached Africa. From London he went to Brussels, where he was decorated by King Albert, and then he made a tour of Belgium and the Rhine districts round Coblenz. Returning to London, he was struck down by a cerebral hæmorrhage on the 30th of May, and was taken critically ill to Millbank Hospital. It had been arranged that he should visit the King at Buckingham Palace to receive the Order of St Michael and St George in recognition of his great work for humanity and his services to the British Forces during the War. Instead, the King, departing from the usual etiquette of Court, went to Millbank to see Gorgas and personally bestowed upon him the Order, talking with him about his work. Gorgas did not rally and, to the profound sorrow of the British people, he died on the 4th of July 1920. By the King's command a State funeral was given him with full military honours

in St Paul's Cathedral, and thousands of citizens thronged the streets to pay a last tribute to America's great dead. A British man-of-war conveyed his body to his own land, where he was buried among the famous departed of the great American nation.

As Gorgas was not a man who would have cared for a monument in bronze or marble, it was proposed by his fellow-workers that a research laboratory should be established in his memory on the Isthmus of Panama, where with the constant traffic of ships, every tropical disease presents itself. A Bill for the establishment of this laboratory passed the House of Representatives and the Senate in April 1928, and on May the 7th it received the President's approval and became law. There will thus arise in the place where his greatest work was done, a fitting memorial for a man of science.

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HERMANN M. BIGGS
1859-1923

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HERMANN M. BIGGS, M.D., LL.D., D.Sc.

1859-1923

Of Dr Hermann Biggs, one of the world's foremost health administrators, Dr Winslow, Professor of Public Health at Yale University, has said: "He was, all in all, the most outstanding sanitary statesman of the United States since the days of Lemuel Shattuck;" and, as if predestined to carry on the work of that Chadwick of America, Hermann Biggs was born in the year that Shattuck died.

Descended from George Biggs who emigrated from England in 1690, to settle first in Long Island and afterwards in New Jersey, Hermann Michael was the son of Joseph and Melissa Biggs, and a grandson of Peter Biggs who fought in the revolutionary war. He was born in Trumansburg, New York, on the 29th of September 1859, educated at preparatory schools in that town and at Ithaca, and worked in a general store until, in 1879, at the age of twenty, he entered Cornell University. His capacity for work and his remarkable powers of concentration enabled him to study medicine at Bellevue Hospital Medical College while he was still a student at Cornell, and thus to take his B.A. degree from Cornell in 1882 and his degree of M.D. from Bellevue in 1883, accomplishing in three and a half years the work to which seven years are usually allotted. This remarkable feat seems to have been only a promise of what

was in store, for in after years, in spite of a not too robust constitution, Biggs carried on an active medical practice while he directed the public health work of the State, taught clinical and preventive medicine, and maintained a personal interest in a multitude of voluntary health agencies, in great part initiated by himself, and kept in close touch with every advance in scientific research which concerned in any way preventive medicine. Any one of these activities would have filled the working life of an ordinary man, and it could only have been because, as a colleague said of him, he was the best user of his time ever known, never idle, never hurried, never seemingly under any special strain, that he was able to carry out so many important and varied tasks. The subject he chose for his graduating thesis at Cornell foreshadowed the direction of his future career, for it was entitled, "Sanitary Regulations and the Duty of the State in regard to Public Hygiene," and was inspired by his association with the brilliant band of workers at Bellevue, including such men as Joseph Bryant, Austin Flint and William Welch. In this essay, he refers to "The grandest discovery of the age—the discovery of a parasite as the cause of tuberculosis by Dr Koch of Berlin," a discovery which was full of meaning for Biggs's future.

From 1883 to 1884 he was house surgeon at Bellevue Hospital, and in the following year went to Germany to study under Professor Loeffler at Greifswald University, and later in Koch's laboratory in Berlin. Only two years had elapsed since Koch's famous discovery of the tubercle bacillus, and the scientific world was buoyant with the hope that a cure for the widespread scourge of tuberculosis was in

sight. Koch, too, following up Pasteur's revolutionary discoveries in fermentation, was establishing the new science of bacteriology on a firm basis, and it was therefore little wonder if Biggs returned to America imbued by that great master with some of his enthusiasm for the promised campaign against consumption. On his arrival in New York, he was appointed an instructor in the new Carnegie Laboratory, then under the direction of Janeway and Dennis, the first laboratory in America to give instruction in the new science of bacteriology. When Welch was appointed to Johns Hopkins University in 1885, Biggs and Prudden were the only teachers of this science in New York. At Bellevue Hospital, with which Biggs maintained his connection till the end of his life, he was constantly in demand to demonstrate Koch's technique, for he had the distinction of being the only physician in the city who knew how to stain the tubercle bacillus.

In 1886 he was appointed Lecturer in Pathology at Bellevue Hospital Medical College, succeeding to the Chair in 1889. He was also a demonstrator in anatomy, and visiting physican to the workhouse and almshouse hospital from 1885 till 1892. In 1887 with Prudden he isolated the cholera bacillus from steerage passengers arriving on the steamship *Brittania*, and this had not been done before except by Koch himself in 1884.

The first work in connection with preventive medicine with which Biggs's name was publicly identified, was that which followed the outbreak of cholera in Hamburg in 1892. This port was in regular communication by sea with New York, and something in the nature of a panic was created when,

following the arrival in New York harbour of some ships with several cases of cholera on board, ten cases occurred in the city itself. All the Southern, Central, South American and Mediterranean ports were closed against ships which had been in New York harbour and business was at a standstill. Chiefly through the precautions adopted by Biggs, the disease was arrested and a most serious interference with commerce avoided. In the same year, on his advice, the first municipal diagnostic laboratory was opened by the New York City Board of Health, and Biggs was appointed Pathologist and Director. His thorough training in the science of bacteriology and in the methods of Koch, combined with his great ability in the application of scientific discoveries to the problems of public health, fitted him well for the organisation of this department of pathology and bacteriology, and in his capable hands the new laboratory of New York City soon became a model for the world. Koch is reported to have said, when he visited New York in 1894, that Germany would have to wait till a new generation of doctors had been educated before such efficient measures for coping with disease as Biggs had established in New York could be carried out in that country. It was in this laboratory that the diphtheria antitoxin was immediately applied on the announcement of its discovery by Roux at the Congress of Hygiene and Demography in Buda-Pesth in September 1894, for under Biggs's direction, Dr W. H. Parks had already begun work on the diagnosis of diphtheria by culture methods in 1893, and New York was fully prepared for the advance in preventive medicine which this discovery foreshadowed. Biggs was in Europe when Roux's announcement was made, and

he did not wait for his return to New York before he set in motion the measures necessary for procuring the antitoxin, but cabled to Dr Parks, instructing him to begin immediately to immunise horses.

The diphtheria germ, the *Klebs-Loeffler bacillus*, was discovered by Klebs in 1875, and Loeffler, with whom Biggs had studied in Germany, obtained the germs in pure culture in 1882. It remained for Roux and Yersin, disciples of Pasteur, to separate by filtration the toxin produced by the germs from the germs themselves. This they accomplished in 1888-1890. They then had a toxin free of germs, and found that it produced, when injected into animals, the same effects as the disease itself. By 1890, Behring and Kitasato had succeeded, by giving graduated doses of this toxin, in immunising animals against diphtheria, that is to say, the animals were made proof against the diphtheria germ. The results of the first human cases treated with the antitoxin were published in 1893, and in September 1894, when there could no longer be any doubt about the success of the treatment, Roux announced it to the world. Thus it was that Biggs cabled to New York to have horses immunised so as to procure an antitoxin for American hospitals without delay. A healthy horse is painlessly immunised by graduated doses of toxin. In answer to the effects of the toxin, its blood produces an antitoxin with which to fight the poison, and it is this antitoxin which is taken from the horse's blood and given to the diphtheria patient to reinforce his own defences against the powers of the diphtheria germ. The horse is not necessarily any the worse for this operation. There is a story told in the *British Medical Journal* of the 24th March 1900, of a horse

presented to a Havana laboratory in 1895 which, by its contributions of antitoxin supplied from its own blood, had benefited 1858 individuals who had diphtheria and was none the worse itself.

Two months after Roux's announcement had been made, the Metropolitan Asylums Board of London used the antitoxin in all its hospitals. But not all the hospitals in Europe were so ready to apply the discovery till the enormous saving of life in those hospitals where it was used compelled them to do so. The rapidity with which Biggs immediately introduced the measures to New York and carried eventually medical opinion with him would, if he had done no other service, alone place him in the front rank of eminent hygienists. He saw at once the saving in life that would be effected, and with a courage which never failed him when he had taken his decisions, he led the way. The results of the introduction of the diphtheria antitoxin are a commonplace now. But the *British Medical Journal* of 20th October 1895, referring to the matter, said: "The most striking confirmation of the value of antitoxin has been afforded where the supply ran short during an epidemic. In Baginsky's clinic, the interruption of the serum-treatment promptly raised the mortality from 15·6 per cent. to 48·4 per cent." Acting on Biggs's advice, the Health Department of New York supplied antitoxin free of charge to all those who were unable to pay, and this practice was adopted by nearly all the municipal and State departments of the United States.

In 1902 Biggs was appointed General Medical Officer of Health for New York City, an office which he held until 1913, while continuing his work as

Director of the Laboratory. His effective work in the cholera scare of 1892, combined with the methods he introduced for the systematic examination of steerage passengers from cholera ports, the introduction of the diphtheria antitoxin in 1895, and the rapidity with which he stamped out a typhus epidemic in New York City in 1897, had already established his fame as a great health administrator; but the work with which his name is most generally associated is that which he carried out in the campaign against tuberculosis. Even as early as 1887, he had been a member of a committee appointed to advise the Health Commissioner as to the best means to be adopted for the prevention of this disease; but the recommendations of this committee that tuberculosis be classified as a communicable infectious disease, and that the health authorities should enforce regulations for its control, were greeted as being far beyond the power of the authorities to carry out in the prevailing state of public and medical opinion. It was not till 1894 that the Health Board felt itself in a position to ask physicians to report cases of suspected tuberculosis and, by the offer of free examinations of specimens sent to the laboratory for investigation, succeeded in getting some cases reported. But physicians were still reluctant to give the names and addresses of their patients. From the first, Biggs recognised the impossibility of enforcing effective preventive measures without the enlightened co-operation of the public and the profession, and not the least among his contributions towards a healthier city must be placed his effective handling both of public indifference and medical opposition. By his long continued efforts and his wise and moderate counsel

he succeeded in gaining the cordial co-operation of both parties. In an "Address on Sanitary Science, the Medical Profession and the Public," delivered before the New York Academy of Medicine in 1897, after defining what is meant by infectious, contagious and communicable disease, Biggs said: "I believe that much could be done to reduce the death-rate from the diseases under consideration if they were managed in an efficient and intelligent manner. Probably a satisfactory result will only be attained by the education of the masses." And, quoting the Medical Officer of Health for Birmingham, he said: "It is noted the social and professional objections to the act controlling infectious diseases have been proved to have no foundations whatever. The distrust and friction between the practitioner and the Medical Officer of Health, which were predicted, have not appeared; the concealment of disease, which was to have followed, has not occurred; the sacred confidence between patient and doctor, which was to have been destroyed with most disastrous results, remains inviolable. And so every theoretic objection which timidity, selfishness, or ignorance could find or invent has been refuted by practical experience."

In the year that this Address was delivered, the Board of Health, acting on Biggs's advice, made it obligatory upon physicians of New York City to report tuberculosis, facilities for the examination of specimens were greatly extended, and arrangements were made for visiting patients not under the private care of a doctor. But even then the new regulation was condemned by the profession and every effort was made to get the Order rescinded. It was not

till 1900 that active opposition to compulsory notification of tuberculosis ceased, and by that time its opponents had done the service of bringing the subject prominently before the public. During Biggs's tenure of the office of General Medical Officer, from 1902 to 1914, a most efficient system for the control of this insidious and disastrous disease was built up by the introduction of far-reaching legislative measures, compulsory reporting of deaths, the circulation of printed instructions of precautions to be adopted in the homes of the people, the establishment of dispensaries, hospitals for advanced cases, and a sanatorium for incipient cases. For these and a great many other measures, Biggs was almost entirely responsible, and the result can be seen by a glance at the death-rate. In 1900 deaths from tuberculosis in the United States were 202 per 100,000, and in 1920 they were 114.

In addition to his work in his official capacity, Biggs was associated with many undertakings of a private nature for the eradication of this disease, and his advice and guidance were eagerly sought by all bodies connected with the work of preventive medicine. He was President of the National Tuberculosis Association in 1905 and 1906, he served on the Tuberculosis Committee of the Charities Aid Association; he was a member of the Rockefeller Institute and its Scientific Director from the time of its organisation, and President of the American Hygiene Association, and his active help in the development of their work was ever at the service of all these bodies for, as Mr Homer Folks, the Secretary of the Charities Aid Association, has said: "Dr Biggs never gave his name without giving also his thought and help."

In the creation of the Bureau of Child Hygiene of the New York Public Health Department, Biggs played a prominent part, and he was in great part responsible for the enactment of the laws controlling the practice of midwives, first in New York City and later in the State and, when Commissioner of Health for the State, it was his influence that secured the passing of the Federal Maternity and Infancy Act, a measure which gave to New York State a larger appropriation of money for its child welfare than that assigned by any other state.

In 1912 it became evident that the work of the New York City Health Department was hindered by the backward condition of public health administration in other parts of the State. To remedy this state of affairs, the Governor of New York appointed a Commission, of which Biggs was elected Chairman, to draft a new public health law. Their report, which in effect was that of the Chairman, recommended the appointment of an expert Public Health Council, under a single administrative head responsible to the Governor, with power to establish a uniform State Sanitary Code; the provision of district sanitary inspectors, and an increase in the pay of local health officers. On this point Biggs had always laid stress, for he held it important to have men of adequate training and education in such positions and, indeed, adequately trained sanitary officers and public health nurses. The facilities he provided for practical courses during his Commissionership of the New York State Department effected great improvement in the efficiency of its personnel.

The Bill embodying the Commission's recommendations was passed by the legislature in 1914

without change in any of its provisions, the Public Health Council was appointed, and Biggs was elected Chairman. He had now resigned from his position as General Health Officer of the City, and when he was offered the office of State Commissioner of Health in addition to the Chairmanship of the Council, he accepted it somewhat reluctantly owing to the increasing pressure upon his time. Nevertheless, from 1914 till the time of his death, he filled both these offices with great distinction, bringing to their development his genius and administrative skill in the solution of the problems which confronted the new Department, and introducing in his splendid laboratory every new method of diagnosis which the rapid advance of science dictated. For science was the basis of all his activities. He had an insatiable desire to know all the facts and, knowing them, an extraordinarily clear conception of the best way to apply them. He seemed to know instinctively the right direction in which to set out for a goal, which was clear to his view, but often hidden from his co-workers, until the goal was at length attained and they could see the results of his foresight. All his life he held the confidence of executives and legislatures of every political opinion, of Governors and of the public.

In 1917 Biggs was appointed a member of the Medical Advisory Committee of the American Red Cross War Council, and early in the same year he was sent by the International Health Board of the Rockefeller Foundation, in company with Dr A. R. Dochez, to investigate the causes of the widespread prevalence of tuberculosis in France. As a result of his report, the Rockefeller Commission for the Prevention of Tuberculosis in France was appointed and

he was chosen Chairman. In 1919 he was one of the American delegates to the Inter-Allied Medical Conference at Cannes which formulated the plans for the League of Red Cross Societies. Of this League he was Medical Director at Geneva for a short time in 1920. In addition to all these activities, Biggs was a member of many professional societies and in 1920 President of the Association of American Physicians.

But the strain of the War years and the ever-increasing demands of his work had told upon his health. In the midst of his labours, he was taken ill in the summer of 1923 and died on the 28th of June at the too early age of sixty-three, leaving a widow, a son and a daughter.

Biggs was a contributor to many medical journals all his life. Such papers as the "Physiological Action of Cocaine," the "Koch Comma Bacillus," "Methods of Bacteriological Investigations," and the "Etiology of Rabies" and many others on tuberculosis, cholera, cerebro-spinal meningitis and sanitary science were the work of his pen. He received the honorary degrees of LL.D. of New York University in 1910, of Rochester University in 1917, and that of D.Sc. of Harvard in 1920. He was also an honorary member of the Royal College of Physicians of Edinburgh.

The news of his death was received in America with universal grief, for he was a man greatly beloved, and his work at the head of the State Department of Public Health had brought him the confidence and devotion of the great American public. In the Hermann Biggs Memorial Lecture for 1928, Professor Winslow of Yale who delivered it, said: "Hermann

Biggs's work must go on. The future holds new challenge for men of intellect and heart and vision. Pneumonia remains to be overcome; influenza, infantile paralysis, cancer, the great unexplored field of mental hygiene—open to us new unconquered countries. . . . We need more leaders like the one whom we commemorate to-night. The best of all tributes to his service will be the enlistment under the same banner of young soldiers of the public health who can realise, as he realised, that by the application of modern science preventable disease can be banished from this earth."

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LIEUTENANT-GENERAL SIR WILLIAM LEISHMAN, K.C.B., K.C.M.G., F.R.S., LL.D.

1865-1926

Sir William Leishman was the only son of a distinguished father, and a grandson "of the Manse," as the saying is in Scotland, for his grandfather, the Reverend Dr Leishman, was the Parish Minister of Govan in Glasgow. His father, also named William, after graduating with honours in medicine from Glasgow University in 1855, rose to an eminent position in his profession. He held the Chair of Medical Jurisprudence in Anderson's College, edited the *Glasgow Medical Journal*, and was appointed Professor of Midwifery in the University in 1868. His contemporaries speak of him as a "dignified and fluent speaker, lucid and interesting, with a distinct literary flavour in his language," and as a strong advocate of the influence of nature in the cure of disease. A member of the Senate, his counsel carried great weight in the affairs of the University and, as the representative of the University on the General Medical Council, he fulfilled the duties of a councillor with distinction. His only son William was therefore brought up in an Academic atmosphere.

Born in Glasgow on the 6th of November 1865, William Leishman received his education in London at Westminster School, returning to Glasgow for his medical course. He graduated in medicine and

Sir William Leishman
1865-1926

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surgery in 1886 and was gazetted Surgeon to the Royal Army Medical Corps a year later at the early age of twenty-one. India was destined to provide him with his first experience of the tropics, and an Indian and tropical disease, kala-azar, with his first scientific discovery. The fact that he took a microscope with him when he left England singled him out from the ordinary Army surgeon of that day, for it was an unusual proceeding, although the germ theory was by that time well established. The discovery of the typhoid fever bacillus by Eberth in 1880 had set the world's laboratories working on researches for a protective inoculation. In Germany, Koch inspired the anti-typhoid campaign, and in India, Leishman and W. S. Harrison set to work on the same problem, and they had ample opportunity of studying enteric fever, for it took a heavy toll of the lives of the British soldier before the days of protective inoculation. To this subject and to the study of kala-azar, a disease which interested him all his life, Leishman devoted special attention, although it was not until his return to England that a satisfactory vaccine against typhoid fever was brought out. Before he left India, he saw active service in the Waziristan Expedition of 1894-95, receiving the frontier medal with clasp in recognition of his services in that campaign.

On his return to England, he was sent to the Army Medical School at Netley, where a brilliant teacher, Sir Almroth Wright, held the Chair of Pathology, and under the influence of his stimulating lectures, Leishman's zeal for research received a new impulse. Almroth Wright was then working on the preparation of his anti-typhoid vaccine for which he became famous, and Leishman was actively associated with him in this

research. Anti-typhoid inoculations were inaugurated at Netley in 1896, and when in 1898 Sir Almroth Wright went to India to serve on the Indian Plague Commission, he took the opportunity to test his inoculations on the British troops at the stations which lay along the route of the Commission's inquiry. For this purpose he had to take out his vaccines from England, but as there was not much time to lay in a sufficient store before starting, his supply ran out. He had, therefore, to manufacture more vaccines on the journey under conditions that were very far from ideal for this important preparation. Nevertheless, the results obtained even on this early experiment showed, as calculated on the returns kept and compared with the number of cases of typhoid and the death-rate for the previous three years, that, if the whole British Army in India were inoculated, an annual saving of over 1000 cases and of nearly 200 lives would accrue. The report of anti-typhoid inoculations was published by Leishman and Wright in the *British Medical Journal* of the 20th January 1900, in a paper entitled "The Results which have been obtained by Anti-typhoid Inoculation," in which they gave a detailed description of the preparation of the vaccine and the technique employed, and from that date up till 1924 Leishman published numerous papers and reports on his work on this subject. "A Report on the Blood Changes following typhoid inoculation" appeared in the *Journal of the Royal Army Medical Corps* in 1906, followed by the "Progress of Anti-typhoid Inoculation in the Army" in the same journal in 1907, and in 1908 two more reports on further experiments were published. The Harben Lecture which he delivered in 1910 was devoted to the same subject;

and, right up to the end of his life, the medical journals testify to the amount of work he did in this connection.

In 1900, having been promoted to the rank of Major, Leishman became Assistant Professor of Pathology in the Army Medical School, and the results of his patient laboratory work soon began to be manifest. His skill in evolving the technique best suited to his researches was a never failing source of wonder to his assistants. A process in constant use in laboratory work is that of staining for microscopic examination, and consists in the injection of colouring matter which acts more powerfully on some parts of the material under examination than on others, thus enabling these parts to be distinguished from their surroundings. The reactions of micro-organisms to staining material vary, and these reactions are examined and recorded. After many months of laborious investigation, Leishman succeeded in preparing the stain which is now known everywhere as *Leishman's stain.* It is a modification of Romanowsky's stain, and he described the technique in papers published in the *British Medical Journal* of 16th March 1901, entitled "The Application of Romanowsky's Stain in Malaria," and in the *Journal of the Royal Army Medical Corps* of 1904, in "Notes on Romanowsky's Staining." The use of this stain led to the discovery of the parasite of kala-azar, a discovery which Leishman made at a *post-mortem* examination of a soldier who had died from this disease at Netley. By taking some material from the spleen and examining it under the microscope he was able to pick out by means of the stain the small parasite which is the cause of this disease and is

now known as the *Leishman-Donovan* body. Kala-azar is a tropical disease, characterised by prolonged fever, wasting, enlargement of the spleen and alteration in the colour of the skin. It is grouped with its Mediterranean form, caused by a parasite similar to the Leishman-Donovan body, and the kindred diseases known as the Delhi boil and tropical sore, under the name of *Leishmaniasis.*

In addition to this stain, Leishman evolved at Netley a most ingenious technique, which has since been extensively used in research work, for estimating the resisting power of the blood to the invasions of infection. The blood corpuscles called phagocytes, with which Mr Shaw makes play in *The Doctor's Dilemma* are those that absorb infectious microbes, thereby protecting the system against the inroads of disease. Leishman's paper on this subject, "Note on the Method of Quantitatively estimating the Phagocytic Power of Leucocytes of Blood," was published in the *British Medical Journal* of 11th January 1902.

In 1902 Leishman married Miss Gunter, the daughter of the late Lieutenant-Colonel E. Gunter of the 59th Regiment, and in 1903, when the Army Medical School was moved to London, he succeeded Sir Almroth Wright in the Chair of Pathology at the Royal Army Medical College. A great part of his time was then given up to teaching, and his lectures at the College were a source of inspiration to those who heard them, for he had inherited from his father a gift of clear and vivid powers of expression which not only held the interest of his audience, but awakened in his students an enthusiasm for the work that was amply reflected in the high standard attained in the

examinations for promotion during the ten years Leishman remained at the College.

In the laboratory he continued his researches in the preparation of anti-typhoid vaccine. The use of this protective measure had been only partially successful in the South African War, and was adversely criticised. But considering that in 1899, when the troops embarked, the treatment was only in its rudimentary stage, the results, as reported in Colonel Simpson's *History of the South African War*, showed a remarkable gain on previous records, for the mortality per thousand of those inoculated was only 10·0 compared with 32·3 of those not inoculated. After summarising the factors unfavourable to the success of the treatment, Leishman said: "It is noteworthy that, in spite of all these factors, the general analysis of the results should show that typhoid was twice as common in the non-inoculated as in the inoculated and, in my opinion, it is even more striking that, in every corps, without exception, the ratio should have been in favour of inoculation." As the result of long and patient investigations and many experiments at the laboratory of the Army Medical College, Leishman produced the vaccine which afforded such complete protection that, in 1914, when the War broke out, typhoid fever, the dreaded scourge of armies in the field, was well under control, and a triple vaccine against it and the paratyphoids had been prepared. Had it not been for this protection, it is estimated that, on a calculation based on the rate at which the troops were affected in the South African War, the total number of cases of typhoid would have reached in all theatres of war the enormous figure of 551,000 with over 77,000 deaths, whereas, during

the years 1914-1918, in all the theatres of war, the total number of cases was only 20,139 with 1191 deaths.

Another research carried out by Leishman at the College in London was concerned with the fate of the spirochætes of relapsing fever in the tick. Relapsing fever, a disease constantly met with in the tropics, is caused by very delicate coiled or spiral organisms, known by the name of spirochætes, which are found in the blood stream, and are conveyed by the bites of lice, or, as in Africa, where the disease is known as tick fever, by the bite of the tick. The technique which Leishman developed for his work on the spirochætes has been described as "at once the admiration and despair of his assistants and colleagues." By its means he was able to demonstrate one phase in the life-history of the spirochætes. He also proved that the infected female tick can transmit the infection through its eggs to the next generation, which in turn can pass it on to another generation without these ticks having fed on infected blood. As a tick is a long-lived insect, this fact adds greatly to the persistence of the disease in any particular place and therefore to the difficulty of eradicating it. Where lice and ticks thrive in conditions of poverty among a native population, relapsing fevers may take a terrible toll of life owing to the impossibility of controlling the means of infection.

In 1909, in recognition of his contributions to science, Leishman received the honour of knighthood, and in 1910 the Royal Society conferred upon him its much coveted distinction, by electing him a Fellow. He was President of the Royal Society of Tropical Medicine and Hygiene in 1911, promoted to the rank

of Brevet Colonel in 1912, and appointed Honorary Physician to the King. On the formation of the Medical Research Committee of the Privy Council, now the Medical Research Council, he was elected a member and served for ten years on this body, devoting much time and thought to the organisation of its research work. In 1913 he resigned the Chair of Pathology at the Royal Army Medical College and became expert adviser on tropical diseases on the Army Medical Advisory Board. His time was now so fully occupied that he could rarely be spared for laboratory work, a matter which he greatly regretted. In 1914 he was elected a Fellow of the Royal College of Physicians.

On the outbreak of war, it fell to Leishman to make provision for inoculating the first divisions of the Expeditionary Force against enteric fever in so short a period that it was not possible to give the two regulation vaccines. The General Officers commanding the Divisions were alarmed lest their troops should arrive at the front, where their services were urgently required, incapacitated for action by the effects of the vaccine. Leishman overcame the difficulty by giving a single dose of double strength, and fortunately no evil consequences ensued. When time allowed, later on, a return was made to the ordinary procedure of two inoculations with an interval between them.

In October 1914, Leishman went to France as Adviser in Pathology on the staff of the Director General of Medical Services with the Expeditionary Forces, and in this position he came in contact with all the research work carried on in the Army. He was Chairman of the Committee on Trench Fever, a

committee which was responsible for the discovery of the mode of transmission by lice of this not fatal but very distressing malady, and thereby opened the way to its prevention; identifying, too, the cause of the disease in the clusters of granules found in lice, related to the *rickettsia* which are suspected of being the cause of typhus fever. The International Allied Sanitary Commission and the Inter-Allied Surgical Conference which met in Paris, also claimed his services and the benefit of his advice. He was three times mentioned in despatches, and received the 1914 Star with clasp, the British War Medal, the Order of C.B., the Legion of Honour and the American Distinguished Service Medal, and in 1918 he was created K.C.M.G. Glasgow University conferred upon him the honorary degree of LL.D.

In 1918 he was appointed Adviser on Tropical Diseases to the Director General, Medical Services, and had to advise on all the pathological problems created by the War, and ultimately he was appointed Director of Pathology. He served in this capacity until 1923, when he succeeded Sir John Goodwin as Director General, Army Medical Services, with the rank of Lieutenant-General, a post which was rendered exceedingly onerous owing to the changes brought about by demobilisation and the necessary reductions in staff entailed by the economy campaign after the War, all of which created much disappointment and unrest in the Medical Corps. Leishman performed his duties with great tact, judgment and distinction in the difficult years following the Armistice, and was created a K.C.B. and promoted to the grade of Grand Officer of the Legion of Honour. He served on the Yellow Fever Commission of West Africa, and on

the Medical and Sanitary Advisory Committee for Tropical Africa at the Colonial Office. In the midst of these great activities, when his tasks were but half accomplished, death cut him off in his sixty-second year, on the 2nd of June 1926. He was buried with full military honours, the Grenadier Guards forming a guard of honour. The King and Queen were represented at his funeral, and tributes were received from all over the world. One which he would especially have valued was sent from the Pasteur Institute in Paris signed by the eminent scientists, Professors Roux, Calmette, and Martin.

Leishman was one of the greatest benefactors the Army had known. His services to the nation and the world at large are to be found in his great contributions to the science of modern tropical medicine, and his memory will be handed down to future generations of scientists by the discoveries which bear his name. But, because he did so much to further the cause of tropical and preventive medicine, he was fully alive to the ever-pressing need for more research. At the Linacre Lecture, delivered by him only the year before his death, he said, after reviewing the progress gained in our knowledge of the cause and treatment of some of the most important diseases which are a menace to life in the tropics, "On the whole, we are too much inclined to congratulate ourselves on the remarkable progress which has been made in tropical medicine during the last thirty years, and to lay stress on what has been done rather than upon what remains to be done. . . . Taking the case of the white resident first, there can be no question that conditions for the maintenance and safeguarding of his health in the tropics have of recent

years improved enormously. Accurate knowledge of the causation of the disease, the diffusion of that knowledge and its utilisation by an efficient health service have, in his case, made life in the tropics, at any rate in most places, almost as safe as at home. . . . Let us turn, however, to the other side, the case of the 300,000,000 of the native races for whom we are responsible. . . . Their condition in many countries is such as should give us cause for heart-searching and for the gravest disquietude. . . . To put it shortly, the native, from the health point of view, is in many countries little, if at all, better off than he was before we accumulated the mass of knowledge from which the white man has benefited and is benefiting so greatly. . . . The obvious causes for this state of affairs are, lack of men, lack of money, lack of knowledge." And of these three lacks, he had most hope for the future from the acquisition of more knowledge. "Tropical research has no reason to be ashamed of the amount of light which it has thrown on dark places, but . . . it is only here and there that this knowledge has proved to be of such a nature that it can be readily, and above all economically, applied to the control of the disease in question on the scale required in practice. . . . The lines of approach are innumerable, and each disease has its own unsolved problems and its own difficulties; but, as so many of them are concerned with insect hosts or transmitters, it is clear that closer and closer study of these and of their life-history is bound to be fruitful. One must get far closer down to the *vie intime* of these dangerous pests, and learn, ever in more detail, their hopes and fears, their tastes and dislikes, their loves and hates; one must get into the very soul of a louse, a flea or

a mosquito, if we are to wrest from it such secrets as we may hope to utilise."

So, with eyes still straining towards a brighter future, Leishman was called from his great work.

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